The Journal of ELECTRICITY POWER and GAS

DEVOTED TO THE CONVERSION, TRANSMISSION and DISTRIBUTION OF ENERGY.

VOL. XIII.—No. 8 SAN FRANCISCO, CAL., AUGUST, 1903. {YEARLY SUBSCRIPTION - $2.00 {SINGLE COPIES - 25 CENTS

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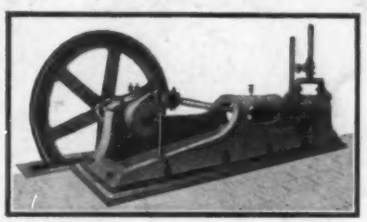

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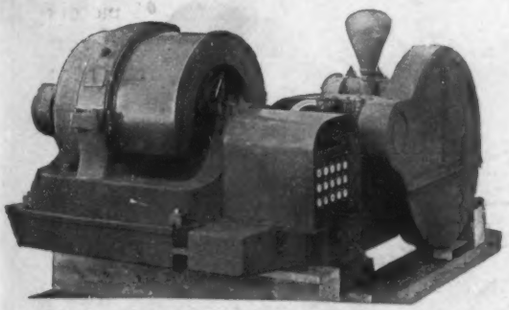

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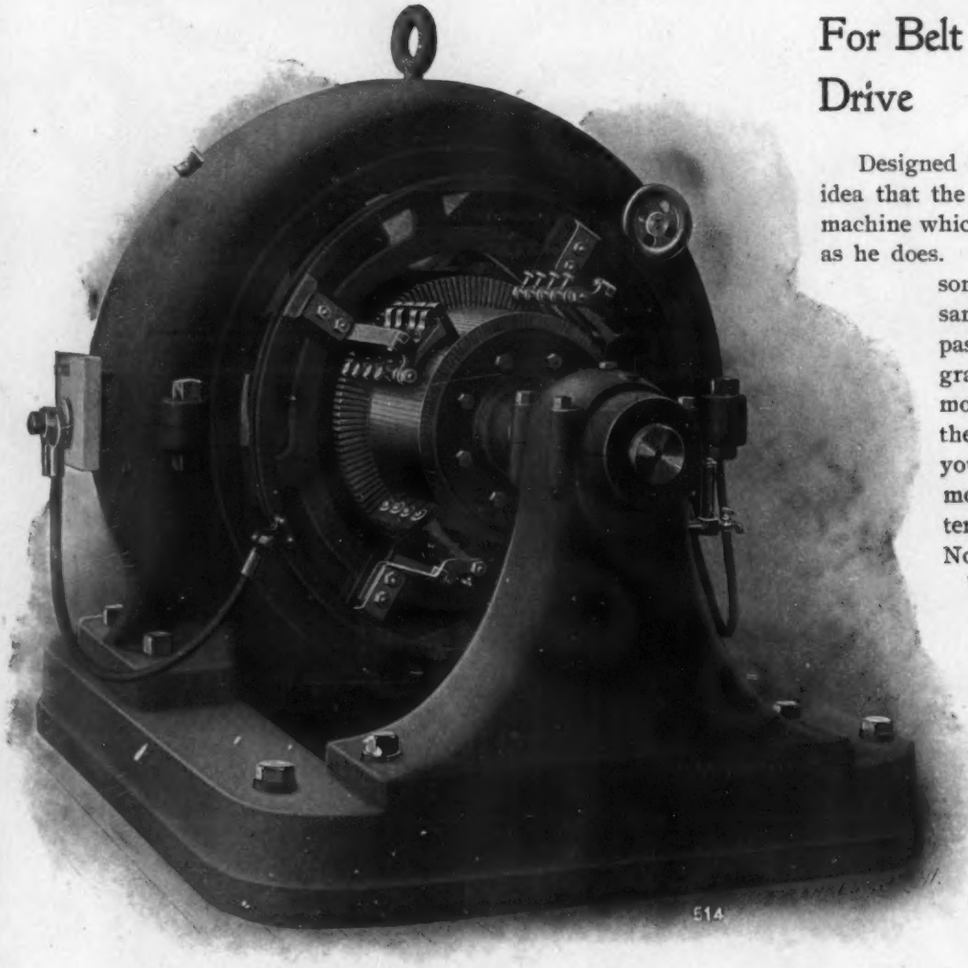

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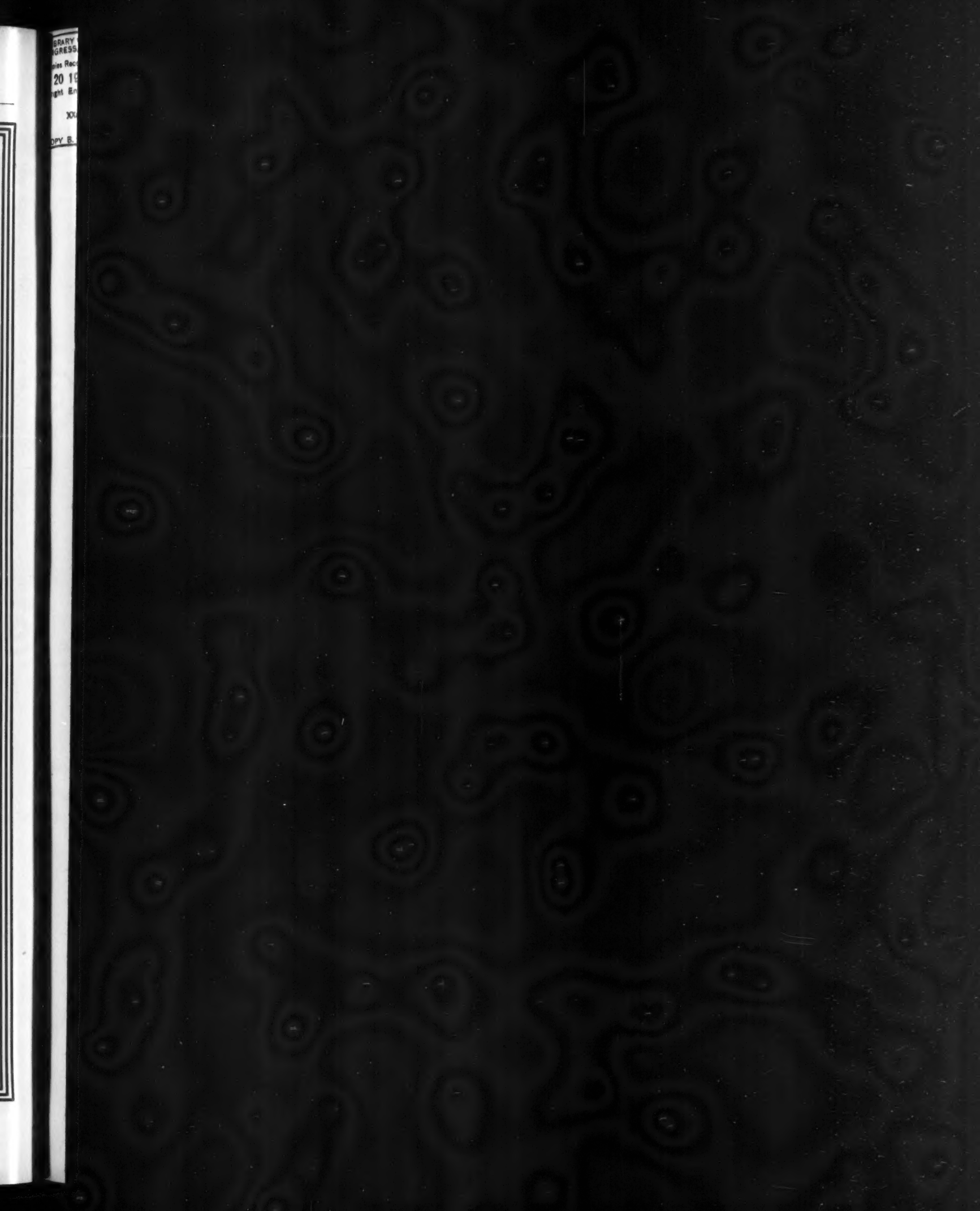

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The Journal of Electricity, Power and Gas.

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XIII. SAN FRANCISCO, CAL., AUGUST, 1903. NUMBER 8

The Seventh Annual Convention of the Pacific Coast Electric Transmission Association.

Continuation of the Interesting Papers Contributed by Prominent Engineers and Read Before the Convention at San Rafael.

ORGANIZATION OF THE OPERATIVE FORCES OF A TRANSMISSION PLANT.

*BY L. M. HANCOCK.**

THE early electrical work, as taken up in this country, started with the development of the important centers where the richest of the business could be gathered. Small stations were installed that would handle a few buildings, or a very limited district, and the organization of the forces, both business and physical, were of a very limited and crude nature. For a number of years this was about the state of the development. A frenzy of development came over the country, and immense numbers of these small plants were established, irrespective of whether the conditions would warrant the work or not.

The companies furnishing machinery put agents in the field to sell the product. These men were, a good many of them, very bright in some respects, and succeeded in the object they had in view, namely, to place a great many of the machines for which they were agents. Many of them acquired enviable reputations as salesmen, and are today in the front rank of the business. However, a great many of them either had little business experience, or failed to get at the essence of the situation, and many of these plants, when times were a little dull, or their apparatus became somewhat old, went into the hands of a receiver, or went out of business altogether. As the desirability of lighting by electrical methods came to be recognized by the people in general, these plants, in many cases, were taken hold of by thorough business men, reorganized, and, in many cases, even rebuilt and placed in the hands of competent men and on a sound business footing, and are today, and have been for a number of years, paying propositions.

It has only been within the last ten years, however, that the idea has prevailed of establishing a large station at some central point where energy is available at very reasonable cost, and from this center to distribute over heavy trunk lines the energy necessary for operating these small plants, which were scattered about the country so promiscuously. As this idea came to be prominent, it became necessary to reorganize and harmonize the interests of the various towns and various local companies in order to carry on the buiness in a successful way. As this idea grew, larger and larger stations have been established, and new ideas have been brought forward for handling and organizing these various forces for the successful operation of the plants as designed.

In the early days, often times one man was the whole thing, from president and director down to coal passer and oiler, he attending to all of the business affairs of the company, and operating his own plant; but, as demands became more and more numerous, he found his time occupied with business affairs and other men took his place at the boiler, the engine room, dynamo and lamp room. Then it was that, when so many workmen were employed, the necessity for a thorough organization and rating of each man became evident.

But the organization of the forces of the plant in a single town is an entirely different affair from that necessary for a transmission company pure and simple. In the town the superintendent has all of his affairs close at hand—his generating station, his lines, his transformers, and everything within, at least, two hours' reach—but, when distances up to 100 and 150 miles have been reached, the superintendent finds himself in an exceedingly helpless condition when he attempts to reach the whole plant for information in a few minutes; and, should his telephone service go wrong, he finds the telegraph altogether too slow, and horses and railroads are of little avail to quickly get his plant into operation in case of serious disaster.

In order to illustrate the methods carried out in the organization of a large plant, let us assume a condition that would fairly represent those in hand. Take, for instance, a plant capable of delivering 15,000 horsepower a maximum distance of 100 miles, the source of energy being a stream from which the water is diverted by a small log crib dam, rock filled, to a flume ten miles in length, without any storage of water, and an effective head of 800 feet at the power house; the machines in the power house to be of 1500 kilowatts each driven by water wheels of the impact type; current from the generators stepped up by means of large transformers to a line voltage of 50,000; the lines to be in duplicate, and presum-

*A paper presented to the Seventh Annual Convention of the Pacific Coast Electric Transmission Association, June 16-17, 1903.

ing, of course, the generating station would be well into the mountains, necessitating heavy construction for the line in order to reach the valleys where the energy is disposed of. Supposing there are three switching stations on the line; there are four large substations and twelve small ones for the distribution of energy; that a large proportion of the energy is delivered at the extreme end of the lines; that quite a large street railway load is handled, and also that there is a lighting load, giving quite a peak, in the early evening hours; also that there is a large proportion of the load used constantly twenty-four hours a day, and another large proportion used only in the day time. This will fairly represent the conditions as they exist with the largest of the transmission companies in our State.

The question comes now, how to man this plant so that it will successfully serve the customers secured, and keep doing it continuously. The water conditions surrounding the plant are such that extreme care must be taken to keep a full flume of water, somewhat more than sufficient to handle the whole plant, flowing continuously. This means that all repairs must be taken care of while the plant is in operation, and that extraordinary expense in many cases will have to be taken in order to insure the continuous supply of water.

Extra care will have to be taken, of course, with all power house machinery, lines, and substations, to foresee difficulties, and, if possible, prevent accidents. If thoroughly competent men are employed throughout the work, a great many of the disasters which come to electrical plants can be taken care of before anything serious happens. It is pre-supposed that extreme care has been taken in the design of every item covering the plant, so that there will be a minimum of trouble.

The general divisions necessary for a plant of this size will be about as follows: Hydraulic development, power house, transmission lines, and substations. A general superintendent should have charge of the whole plant who has been associated with the plant from its conception, and who is a thoroughly trained technical man and a man of wide experience in actual practice. He should also be a man with considerable business experience in order to decide in many cases what he shall recommend, so that his recommendations will not conflict with financial practice. He should then have under him a superintendent over each division, and, as far as possible, well educated men should fill these positions. Of course, if they are not obtainable, he will have to select the best from the material at hand. It goes without saying, each one of them should have had considerable experience in his special work. Under each superintendent there should be an assistant, a foreman, and an assistant foreman, except, perhaps, on the substation work.

Under the conditions as stated, the flumes would require one man at the head works, four men located at intermediate points on the flume, and two men at the Penstock. These men, as a general thing, would work in pairs, as it ordinarily happens that flumes of this character are located where it is very difficult to put buildings, and, whatever quarters are installed, would have to be simply a cabin or a long narrow building, placed close to the flume, with, of course, no yard or garden place available. The majority of these men are unmarried, or if married, their families live at some distance. This, of course, makes this class of men more or less nomadic, and, while good wages will hold them for a considerable period, if one is not careful to provide vacations and to arrange for them so that they can relieve one another and get away from their work for some little time each month they get into a condition where they are of little use to their employers.

Besides the force of patrolmen on the flumes, a system of this size would require on an average of from three to five men employed throughout the year, making repairs and working on the general up-keep of the plant. These men would all be under a foreman, who, in turn, would be under a superintendent of hydraulics.

A power house of this size should have as a regular operating force, besides the superintendent, one foreman, one assistant foreman, and three shifts of three men each. Besides this force for the regular operation of the plant, a machinist and helper would need to be in regular attendance.

For the equipment of the substations, the smaller ones could be handled by the local men, who take care of the town, wiring and trimming of lamps and odds and ends of various natures, without having to have a regular force of men kept constantly on duty for their care. The larger substations would have to be manned more carefully, and the number of men, of course, would depend upon the character of the service, and the amount of machinery used to handle it. As outlined above, however, it is likely that each one of the large stations would require on an average at least two men on each shift, and three shifts. By carefully planning the stations, these men could be kept thoroughly employed, and a great deal of the odds and ends that need to be manufactured for the system could be produced by them. This would suppose that there would be installed at one or more of the large stations a small machine shop, with suitable tools for the manufacture of special switches, cut-outs, and various things of that nature, which, due to the rapid development of the transmission idea, have not yet appeared in the regular market. The larger substations will require a foreman, and if auxiliary generating machinery is installed, an assistant superintendent. All of these would come under the substation superintendent at all of the substations and some one man must be in general charge as foreman.

The force of men outlined above should be very carefully selected and drilled for their work. At present men of a suitable class, with large experience, are not obtainable, and it is necessary for the superintendent to be able to educate men for the work he has in hand. Oftentimes men will give good service if only properly told what is wanted of them, but in too many cases they are supposed to know by intuition, without ever having had any experience. A great many mistakes happen that

could be avoided if men thoroughly acquainted with the work and needs of it could be secured, but in the present state of the art, these are not available.

The switching stations will have to be taken care of according to the local conditions, and it may be found advisable to keep men at all of the stations a part of the season, or it may be found that the patrolman can handle them satisfactorily. It often happens that during stormy weather, under conditions existing in our State, an extra force of patrolmen have to be employed, and also that extra men have to be held at the switching stations and other important points in order to meet emergencies that come along. However, this also depends upon the care with which the plant is designed, and how well the engineers looking after that part of the work foresaw what would happen, or how carefully they studied the conditions to be met, or how accurately they weighed all of the conditions to be considered.

There is no especial reason, from a theoretical standpoint, why a pole line should not be designed to require as little care and attention as an ordinary pipe line, if engineers will only as carefully study the conditions to be met, and if boards of directors can be brought to see their way clear to devote sufficient money to the building of pole lines, so that advanced ideas can be carried out. By advanced ideas I do not mean freaks and fancies as they are so often presented to us.

The force of patrolmen necessary will depend largely upon conditions as they exist after the constructing engineers are through with their work. As high tension pole lines have been built in the last four or five years, it is necessary to shorten up the length of each patrolman's beat a great part of the time to about fifteen miles. This enables him to cover his beat carefully every day, and, if climatic conditions are not severe, he can cover it twice a day, besides doing some little work along the line to keep himself in good physical condition, and enable him to eat three meals a day, and sleep his allotted hours. Over these patrolmen there should be a foreman of considerable force of character who will get around among them, meeting up with each man as often as two or three times a month, going over his beat with him, spurring him up to better effort, and educating him to the desired degree. Patroling of the pole line is one of the dullest pieces of work a man can be put at, although a current of exceedingly high pressure may be traversing the line, and work of very great value be going on where energy is delivered, yet there is absolutely nothing happening on the satisfactory pole line that would help a man to keep up to the desired pitch of enthusiasm necessary. The section man on a railroad every few hours has to step to one side to allow trains to pass, and, while he may for a time get indifferent or careless, the passing of the fast trains spurs him on to renewed effort, and gives him an exhilaration that helps to a great degree to keep his enthusiasm up to the proper pitch, whereas, with pole line work, although you might say, a constant string of trains are passing, there is nothing to enthuse the patrolman, and it is only when an accident happens that he gets an exhibition that shakes his confidence in the appearance of things. The duty of the line superintendent, as well as the under officer, is not only to educate his men up to the proper degree and get them enthused, but to keep them up to their work at all times.

Under the line superintendent there will probably be a construction force. He will probably have to maintain, at least, one repair foreman, who will have a force of four or five men under him. These men will have to be moved from one end of the system to the other to take up whatever work comes up, by way of repairing, changing the lines, and also making extensions. The changes and repairing of substations will hardly require a special construction force, unless the plant is growing rapidly.

ELECTRIC POWER FOR MINING PURPOSES.

BY GEORGE SCARFE.

THE subject of electric power in Nevada County has, I believe, been thoroughly gone over previous to this time, and this short paper is perhaps better suited to a convention of mining men than to the present meeting; but, as there are many things of interest coming up all of the time in our business, and, although I may repeat an old story in part, still I hope that there may be something new and of interest as well.

When electric power was first introduced in the Nevada County mining district, it found the field well supplied with a fine system of water ditches and pipe lines, supplying power to a great many mines and other industries; in fact, it is an ideal water system, and is still furnishing a first-class power, and the success of electricity in this district does not in any way mean that there is less water used than before; but it shows that electric power has, by its flexible nature, created a field for itself. The reason for this is, perhaps, to be explained by the fact that many mines have been opened up above what may be called the water line, that is, they are above the ditches, or so little below them that water power is out of the question; also many that previous to the event of electric power were operated by steam, but had to close down owing to the excessive cost, are now again opened up and are being successfully operated with the new power. To mines situated as above, electricity has solved the problem to the satisfaction of all.

The location of mines at different levels below the source of water supply calls to mind a curious condition in regard to water power, which is this—water is sold at a fixed price per miners inch, regardless of the head. A man, for instance, buys an inch of water at the ditch and irrigates his garden with it; his neighbor, who is 100 feet below the ditch, buys an inch, and is able by the use of a small wheel to generate about one-fifth horsepower with the inch, and water his garden as well, and at the same cost as his friend above pays for irrigation alone. Now this is a condition we find, for suppose that a mine should be developed at, say 100 feet below the ditch, and water power is used, they will get about .19 of a horsepower for each inch bought, assuming that the wheels used have an efficiency of 70 per cent. At the same time

another party has a mine 600 feet below the ditch, and for each inch he will get 1.19 horsepower at the same efficiency. The first party gets his power for 64.2 cents per twenty-four hour day, and the second party gets his for 13 cents per twenty-four hour day, or $25.26 as against $3.90 per horsepower-month of thirty days. This explains in part why the two powers have separate fields, as there is a point where the two are equal, for if you are getting, say 1 cent per kilowatt-hour for electricity, and the motors have an efficiency of 90 cent., then a water wheel with an efficiency of 70 per cent. at a head of 402 feet will cost the same per horsepower-month on continuous power, such as driving an air compressor or pump, but when it comes to intermittent work, such as hoisting, the head of water would have to be still higher to meet electric driven machines at the prices in mind—1 cent per kilowatt-hour and 16 cents per inch for water—and any mine with less than 402 feet head cannot afford to use it in place of electricity.

For driving a quartz mill there is nothing to be compared to the synchronous motor, as it gives a steady speed, which can only be changed at the power house. The returns from a mill driven by a motor of this type above the same mill driven by water is often enough to pay the monthly power bill. We have in Grass Valley one mill of forty stamps and sixteen concentrators driven by an eighty horsepower synchronous motor that bears out this statement. The electricity is brought to the mine by the power company, where it is metered, while in the case of water it is measured at the ditch, and, again, the convenience of cutting off the power by simply opening a switch is in favor of the last named.

There was another condition which had to be met on introducing the power into this district. Many of the mines were all equipped with steam power, and to get the business started it was necessary to make the change as cheaply as possible, and many interesting outfits are to be seen. In some cases the old engine is still in place, the connecting rod being disconnected from the crank, the old flywheel is built up and lagged to take the belt from the motor; then, again, the motor drives a line shaft, which, in its turn, drives, in some cases, a compressor, cornish pump, hoist, and, in one case, the mill was driven from the same shaft. In this case the hoist was of the differential type, and has been in operation nearly three years, giving the best of satisfaction. We have also the synchronous motor driving a direct-current machine, which, in its turn, operates motors of the railroad type for hoisting, which has been very successful; but most of the large units are used to drive air compressors, for a good deal of pumping is done with air, the steam pumps using it in place of steam, as they did before, and the mines being deep it is a great help in the matter of ventilation, especially in the headings, where the exhaust from the drills furnishes plenty of good air. For this reason I do not expect to see electric drilling to any extent. In the matter of pumping, I think the electrically driven pump is coming to stay with us. We are now installing two in one of the mines; one at the 700-foot level, and one at the 1000-foot. These, we have no doubt, will be the means of many more going in. For the success of these pumps I have no fear, and it will open a new field for electricity which will result in a profit both for the power company and the mine owner.

There is one more application of the power I wish to see, that is, the hoist driven direct by motors of the induction type. When we get that started, it will simply be a matter of time when the mine will be electrically operated throughout.

We have in this district about 2640 horsepower in 133 cycle motors, and 700 horsepower of 60 cycle. The power house on the South Yuba, is, as you no doubt know, the oldest in the Bay Counties system, and the first machines, two 330-kilowatt S K.C. are still as busy as ever. These were originally driven by Tuttel wheels on 190 feet head, but one of them now has in addition, one 600 horsepower Doble working on 800 feet head. In the new addition, we have two 330 kilowatt, 133 cycle, 5500 volt machines, operating with wheels, working under 190 feet head, also each has one 600 horsepower Doble on the same shaft, under 800 feet head.

We are also connected with Colgate, where we have one 750 kilowatt, 133 cycle machine. The power from this machine is transmitted at 24,000 volts to our Grass Valley substation, where it is lowered to a pressure of 5300 volts and paralleled with the South Yuba Plant. We get our 60 cycle current from the Colgate system.

In regard to the operation of the power house, I would say we have had no interruption in our service, caused by any trouble in the power house, for over a year; but, being connected with so many mines, occasionally something will happen that will cause a shut-down of a few moments duration. It is generally someone burns up a switch, or goes in out of step. We are, however, getting these occurrences further apart by putting in a proper switch at each mine, with cords or some device for handy and quick opening, and very often a shut down is saved in this way. We early found out, too, that with the individual cut-out, one in each line wire, we always had trouble with the motors that were directly connected with the line, running on the 5000 volts, for on opening one leg of the line, it then threw all of the load on the other phase, and in opening the second cut-out, we would get all kinds of fireworks at the cut-outs and power house, and most likely at some mine. This has all been overcome by putting in line switches and cut-out switches at the mines that open all four legs at once, and with this method, we have not lost a coil, nor had a shut-down from this cause since they were installed. To further provide against trouble, we have an electrical test, consisting of putting the full working voltage on each machine, first from armature to frame, then from phase to phase; also the hydraulic part is opened up and each wheel gone over in a thorough manner. This is done on each machine once in two weeks and we have found many little troubles that you could not notice while running, or by casual inspection, that, if left much longer, might have caused a serious shut-down.

The Seventh Annual Transmission Convention.

Official Report of the Discussions Held Upon the Papers Read Before the Recent Meeting of the Pacific Coast Electric Transmission Association.

REPORT OF PROCEEDINGS.

Proceedings of the Seventh Annual Convention of the Pacific Coast Electric Transmission Association, at Hotel Rafael, San Rafael, June 16, 1903, E. J. de Sabla in the chair.

PRESIDENT DE SABLA. Gentlemen, the meeting will come to order. I was going to make an address of about ten minutes duration, but we have taken up that time in the club-room, so we will dispense with it. I think that was very much to your profit and my pleasure—possibly to your pleasure, also. We will get right down to business. The first paper that we have is by Professor McAdie, which he will read.

[Professor A. G. McAdie reads paper.*]

THE PRESIDENT. Are there any questions that any one would like to ask Professor McAdie upon his paper? If not, we will proceed to the reading of our second paper.

MR. F. V. T. LEE. Mr. President, we have seen a good deal in the papers about the new metal, radium. I think that Mr. McAdie knows a good deal about it, and I think a good many of us would be interested in it. Would it be out of order if he would be good enough to tell us in a popular way about what he knows of radium?

MR. MCADIE. Mr. President, and gentlemen, I don't know very much about radium. I know very little about it. I wish I did know something about it. Progress is so rapid that a man can hardly keep up with what is going on. We simply know that the element exists—that it has the strange property of giving out these etheric radiations. That is about where we stand at present. The hunt has just begun.

THE PRESIDENT. Is there any knowledge yet as to its commercial value?

MR. MCADIE. Yes. It is very high priced at present; a fictitious value.

THE PRESIDENT. Is there anything known as to its ultimate value?

MR. MCADIE. I believe it will come down as soon as there is a demand; ultimately it will be manufactured and sold commercially. The point is that it promises—and that is why I mentioned it before the convention—some clew to the secret of atmospheric electricity. Atmospheric electricity—the electricity of the atmosphere—has been a bugbear to scientific men for 150 years—from the time Franklin first noted the identity of lightning and high potential discharges—and it will probably be through a study of the ions that we will get into the secrets of the electricity of the atmosphere.

THE SECRETARY. Mr. President, one point regarding the scientific phase in reference to radium is the statement attributed to Lord Kelvin, that for the first time in the history of science the law of the conservation of energy has been attacked by this new element—radium; and he bases this belief upon the published statement, which seems to be authentic, that radium possesses the quality of giving forth heat without any appreciable diminution in its weight. In other words, it is a heat producer without being materially consumed in any way that is so far known to science. That is one of the peculiar features of radium which has been discussed recently in a paper by Mr. Hammer, before the American Institute of Electrical Engineers. Truly, it is the most marvellous substance that we are acquainted with now.

*THE JOURNAL, Volume XIII, page 257, July, 1903.

MR. GEORGE SCARFE. I would like to ask how radium is produced.

MR. MCADIE. It is quite an elaborate process. Professor Currie and Madam Currie first obtained it from pitchblende.

THE SECRETARY. I may say in supplement to Mr. McAdie's last remark, that radium is produced from pitchblende, and to get a most inconceivably small quantity necessitates the handling of several tons of pitchblende, in fact, it is considered that gold is far more plenteous in sea water than radium is in pitchblende.

THE PRESIDENT. We will proceed to the reading of the second paper, by Mr. Ridley, on "Electric Automobiles as Income Producers to Central Stations."

[Mr. A. E. Brooke Ridley reads paper.*]

THE PRESIDENT. You have heard Mr. Ridley's paper. Are there any discussions, or any questions you would like to ask Mr. Ridley, especially as to what his ideas are as to the service of automobiles for rough work, and their adaptability to our mountain work. Mr. Scarfe travels in the mountains a good deal and uses a horse. As Mr. Ridley said in his paper, there was nothing that the horse did that the automobile couldn't do better. I think that Mr. Scarfe might ask Mr. Ridley some questions as to whether an automobile would do, up on the roads in Nevada County.

MR. SCARFE. Mr. President, I think that Mr. Ridley had better take a trip over our mountain roads to the power house. I would not ask him to go up there now. We have one grade there of 20 per cent. How would it work in this decomposed granite on a grade like that?

MR. RIDLEY. As I have mentioned, the automobile is not at present constructed for that class of work. It is simply a matter of design. It will work over anything. I can take my machine over any grade in San Francisco, to 22 or 23 per cent., but while that machine is one of the heaviest built, it is not built strong enough to do that every day.

MR. SCARFE. Say to use it in place of horses and buggies—is there a machine built that we can use?

MR. RIDLEY. No. On rough mountain roads there is no machine, in my judgment, that is adapted to them.

MR. SCARFE. Counting out the roughness of the road—that road is comparatively smooth, but it is composed of a loose granite formation. Wouldn't the wheels simply revolve and settle.

MR. RIDLEY. We have a special class of tire for sandy roads. The purpose of my paper was not for that class of work; it was to encourage the use of automobiles in places like San Jose, Sacramento and Stockton. There is an immense field there, and everybody is deterred from buying automobiles because they have to pay $400 for a motor-converter to charge the battery, and they object to putting in that on top of the price of the automobile.

MR. SCARFE. I would like to have the automobile have a chance to do the work.

MR. RIDLEY. A suitable machine can be designed, but it would be hard to get it built now on account of the congestion of orders in the factories for standard machines, but there are hundreds of automobiles built which are suitable for a large portion of territory covered by power transmission. The fact that I wanted to bring before the Association is that they would be a source of income to the power transmission companies in suitable locations.

MR. F. M. RAY. In regard to what are called the hack lines that have been established in different cities, for instance, there was a line established in Honolulu which was a failure, I under-

*THE JOURNAL, Volume XIII, page 268, July, 1903.

stand, and another line in Chicago. Do you know the principal cause of these companies being failures?

MR. RIDLEY. The cause of the failure in Honolulu was that the machinery was defective in design and construction, and the purchasers could have ascertained this had they made careful inquiries before buying.

MR. RAY. Was it not due to the fact that the vehicles themselves were so heavy that the tire question was one of the great items of expense?

MR. RIDLEY. The tires were too light for the weight of the batteries, and the batteries were not good, and the motors would not run, and the underpinning was not of a style to sustain the weight it had to. The springs and reaches and brakes were such that you couldn't go more than five or ten miles without breaking down. The electric portion gave the least trouble of the whole thing. The carriage portion gave more trouble than anything else. In the East, the trouble they had in Chicago and in three or four other cities was that the companies were formed on a stock jobbing instead of a business basis, and when the water was squeezed out of the stock there was nothing left except some old machinery. In New York, on the other hand, the people stuck to it, and they have now a very large and profitable hack service, increasing every day. In fact, they have had to take most of the hacks off the street, because they can't fill the demand for private calls.

MR. LEE. My understanding of Mr. Ridley's paper was that it had reference particularly to electric automobiles for such service as delivery vans. I don't think the most enthusiastic electric storage battery man, or electric automobilist, would recommend an electric machine for going over the Nevada County district, or about any mountain district in California. But in New York and the Eastern cities they are used to a great extent as delivery vans, and I think that is where there will be a considerable source of revenue for the power companies. In a city like San Francisco, with a little judgment they can get these wagons over practically any part of the city. There are very few hills in San Francisco that you can't go around. A great many you cannot go up without a great expenditure of energy, but you can go around them and accomplish the same thing. The trouble in San Francisco, I understand, is that they put almost anybody in charge, because it is apparently a good deal easier to drive than a horse, and all you have to do is to move a lever to make the machine run. The result is that the batteries do not get anything like proper service. I think, however, that this is the service for which the automobile is best fitted. In reference to street car service, or anything of that sort, I think the experience and failure on the Thirty-fourth Street, New York, system is sufficient to put that out of consideration; but for delivery wagons, for ambulances and patrol wagons and things of that sort, where there is no chance of the batteries running down—that is, where they will always be near stations where they can charge their batteries, in cities like San Rafael, for instance, the butcher or the grocer could use them as delivery wagons, and they would never be very far from the charging station. They have their instruments, and if they use any judgment at all they won't run down. They will always keep within a charging radius. But I don't think for other vehicles, where you want a large range of action, or for street car purposes, or for mountain work—general country work—that the electric automobile is to be really considered. But it is quite a large source of revenue, particularly in the New York stations. The hacks there are very popular, the novelty has worn off and people like them because they can get there fast. In regard to Chicago and Boston, I think Mr. Ridley's reason for the failure was the true one—that they had a little too much water in the concern, and water is not good around electric machinery.

THE SECRETARY. The thanks of the association are certainly due to Mr. Ridley for indicating a means for increasing the revenue of the central station. In discussing the relative merits of different automobiles, it seems to me we are getting away from the main point in Mr. Ridley's paper. As I understand it, it is suggested, in so many words, that it is advisable for central stations to develop the electric automobile solely for the purpose of increasing the sale of electric current. Mr. Ridley's suggestion implies the expediency of installing charging stations at convenient places, like roadhouses. To what extent they would become income producers, Mr. Ridley, as I understand it, has endeavored to point out.

MR. VAN NORDEN. There was a point made in the paper that it would be simply a matter of design in which an electric automobile could be made, so that greater speed or greater radius of action could be gotten. I use a gasoline automobile in which I have to take trips sometimes forty or fifty or sixty miles, and I have to take them at an average speed, perhaps, of sixteen miles an hour. It is a well known fact that if you want to go sixteen miles an hour, you have to use twice as much power as you have to go, say ten. If you want to go sixty miles you have to have, perhaps, twice as many batteries as you would have to go thirty; four times as much battery power. If you have four times as much battery power you have, at least, two or three times as much weight. When you have the extra weight, say twice as much weight on the machine, you have to have much more power to drive it. Isn't that going to revert back where you get to the point where you can't design the machine to carry the amount of power to carry the weight? In other words, isn't it impracticable?

MR. RIDLEY. Electric automobiles are not at the present time built for such service; but you can make electric automobiles to run 200 miles. This, however, is unnecessary if you can obtain storage facilities, so that you can run into a town and get the current you require. With regard to amperage, it takes twice the power to get twice the speed, and always will; but you do it in half the time. I am having a machine built now that will run twenty miles an hour for forty miles, with batteries 10 per cent. larger than used in a machine running thirteen miles per hour for forty miles, and the economical running point is on the twenty-mile speed.

THE SECRETARY. At what rate do you charge automobile batteries?

MR. RIDLEY. You can get it pretty nearly half charged in half an hour to an hour, if you want to. The second half must have a slow charge and the last quarter very slow, or the acid will be boiled out. Heating of the plates from too great excess of current must be avoided.

THE SECRETARY. To an extent, that feature handicaps the electric automobile over the gasoline motor vehicle.

MR. RIDLEY. It does to a certain extent, and the gasoline automobile is going to be a large factor for many years to come. I am not saying anything against the gasoline automobile; in fact, that is an income producer, as current is required to charge the batteries used for spark ignition.

MR. LEE. What is the average rate for charging storage batteries as far as used now on the coast? So far as electricity is used for that purpose, what is the average commercial rate for that purpose. What is the rate that the companies are charging, the kilowatt rate—the cost per kilowatt?

MR. RIDLEY. There are no other electric automobiles outside of San Francisco, except two, one in Stockton and one at Menlo Park.

MR. LEE. I thought they were using quite a number of them in Los Angeles.

MR. RIDLEY. I referred to northern California. I don't know what the Los Angeles price is. They are using a large number there. Some gentleman from Los Angeles ought to be able to tell that.

MR. LEE. What do they charge in San Francisco per kilowatt for charging automobile batteries?

MR. RIDLEY. Six cents.

MR. LEE. How does that compare witn the cost per mile of the gasoline vehicle?

MR. RIDLEY. It is about the same—a little under a cent a mile.

MR. T. E. BIBBINS. When I was in New York a few days ago I noticed that the automobile was being used by the electric companies. For instance, the New York Edison Company had a large truck on which they would carry their transformers and so forth around, and at the forward end they would have a winch, and could use the storage battery power for hoisting the transformer into place. I should think that would be a very handy tool. I believe that that has been extended to safe movers, for instance. I think there would be a definite field in such towns as Sacramento and Oakland—wherever there are not too many hills for such vehicles as that.

MR. C. W. HUTTON. It seems to me that it would be a good idea for the companies to put some money into the electric automobile. Take, for instance, your connecting-up wagon, your trolley repair wagon, and rigs of that sort. This work could be handled by electric automobiles, and it would undoubtedly be an incentive for others to use vehicles of the same sort. The delivery wagon business could be considerably developed. For instance, in Sacramento one firm is using a gasoline automobile to do their delivering; and these people, it seems to me, are simply holding back, waiting for somebody to start the ball rolling. If the electric companies would start in by using one of these rigs themselves, it would undoubtedly be an incentive to others to try the same thing, and I think, for instance, as I said, they might be used for runabouts. For instance, you have your inspector who has to go out and look at different jobs and take care of trouble, and look after certain complaints—re reading of meters—a runabout would be a very handy arrangement to use; and if the thing was once started it would undoubtedly take hold, providing the electric automobile can be made a commercial machine.

THE SECRETARY. The educational feature of a thing of that sort, from the standpoint of the people, would, it seems to me, be of value. If central stations can give a sort of paternity to electric automobiles, and if these vehicles are deserving, it would bring about the use of appliances that would result in the further consumption of electric power, which is what all are after.

THE PRESIDENT. Is there any further discussion in this matter? If not, we will have Mr. Scarfe's paper.

[Mr. George Scarfe reads paper*.]

THE PRESIDENT. You have heard Mr. Scarfe's paper on a subject that is quite interesting. I think in all probability there will be a number of questions that will be asked him, and some discussion ought to be provoked by the subject.

MR. HUTTON. Mr. President, I noticed that in Mr. Scarfe's paper he laid stress on the fact that a synchronous motor is very satisfactory in driving a stamp-mill, on account of the regularity of the speed. I would like to ask if, under similar conditions, he has had trouble operating an induction motor, where a synchronous motor would have done away with such trouble, as far as speed regulation is concerned.

MR. SCARFE. We have not replaced a synchronous motor with an induction motor; but we find that in a mill driven with an induction motor there is more variation of the speed; the speed will change with the voltage, somewhat, while the synchronous motor has to stay with the power house.

THE PRESIDENT. You have had a mill driven by an induction motor, and also by a synchronous motor?

MR. SCARFE. Yes.

THE PRESIDENT. And your experience has been in favor of the synchronous motor?

MR, SCARFE. Yes. The experience we had shows that when the voltage from any cause in the power house was lower than the induction motor, the mill would run slower, and directly they would come up with the voltage it would increase the speed. That is, there was more variation.

MR. HUTTON. Isn't that a question of voltage regulation rather than a question of the style of motor? If, for instance, your voltage regulation is so bad that it drops below the breaking down point of an induction motor, wouldn't you also be likely to have, with a synchronous motor, under rather heavy load conditions, practically the same thing? In other words, wouldn't your synchronous motor be likely to fall out of step?

MR. A. H. BABCOCK. As I take it, what Mr. Scarfe means is that the speed of the synchronous motor, as long as the voltage stays so that it can develop sufficient torque to pull its load, is synchronous with the power house. There is no slip. But with the induction motor, the speed varies with the voltage. That is, a variation in voltage, no matter how slight, causes variation in the speed of the induction motor, and with a stamp-mill it is very necessary that the speed should be constant. The stamps are adjusted to drop at a certain speed, and their pulleys, or whatever driving mechanism they have, are adjusted with that end in view. If they get a variation in speed they lose some gold.

MR. SCARFE. Yes.

THE SECRETARY. Do you refer to synchronous motors at 133 cycles or at sixty cycles.

MR. SCARFE. Either. You can cut half the chance of trouble, anyway, by having a synchronous motor. If the power house runs steady at a certain speed, it don't make any difference what the voltage is, so long as it is enough to supply the motor with current, your motor will run along steadily, where, with an induction motor, changing the voltage will drop the speed or raise it. With a synchrouous motor it would not. You have to change the speed of the generators at the power house to change the speed at the mill.

THE SECRETARY. I wished to draw out a comparison, if possible, between the results obtained with sixty cycles and 133 cycles.

MR. SCARFE. I don't see any difference in the actual working results between the two systems. Of course, our 133-cycle system we run practically by itself. But there is no difference that I can see between the sixty-cycle and the 133, as far as the operation is concerned. The miner doesn't know whether he is getting sixty cycles or 133 cycles.

THE SECRETARY. Does the 133-cycle synchronous motor hang on as well as the sixty cycle?

MR. SCARFE. I think it does. It apparently does with us. We have a sixty-cycle synchronous motor at the railroad station, and that has gone out of step where 133 has not, on the same load.

THE SECRETARY. It is interesting to know your experience on those points.

THE PRESIDENT. Mr. Scarfe, in regard to running a compressor with a synchronous motor and with an induction motor—you have had experience with them side by side?

MR. SCARFE. In that place I go with the induction motor right away, especially where I am operating lights on the same circuit.

MR. HUTTON. The speed of an induction motor, of course, won't break except when overloaded, unless the voltage goes below the normal rated voltage of the motor. It has always been my practice in installing induction motors to have the line voltage all the way from 5 to 15 per cent. above the normal rated voltage of the motor. As you all know, as far as speed regulation requirements is concerned, flour mills practically come in the same category as stamp-mills. They require a very steady speed. We have two running with induction motors and one with a synchronous motor. The synchronous motor always gives a little more trouble. In case of a shut down at the plant, there is always a little more trouble in getting started, and it takes a little more time. But aside from that, the synchronous motor has given very good results, and we have never had any trouble with the induction motors as long as the voltage is right. It seems to me that if the induction motor gives trouble from the variation of speed, it is due to the fact that the voltage is not kept high enough. It is much better to operate your induction motor at such a voltage that never goes below a certain point, and it seems to me that if

*THE JOURNAL, Volume XIII, page 279, August, 1903.

you do that you are not going to have any trouble with induction motors on that kind of service. As far as the variation of speed of the induction motor is concerned, in the large sizes the slippage is not more than from 1½ to 2½ per cent., and that amount of variation is not going to bother any kind of a mill. Our mill people say, themselves, that the speed with electric power is a lot steadier than it was when using steam power, for the reason that in running with steam power the steam would vary a few pounds and the speed would vary, whereas with electric power the speed has been much more constant. As far as our experience goes in Sacramento, they are much more pleased, as far as the steadiness of the power is concerned, with electric driving than they were with the steam, and we have had no trouble whatever in the use of induction motors for mill work.

MR. LEE. I think the day has gone by when any of us can say that the synchronous motor is better than the induction motor, or that the induction motor is better than the synchronous motor. Absolutely constant speed is required in many cases. On a large transmission system, even where you have all the modern regulating devices and close regulating machinery, it is impossible to give perfect regulation. If everybody was tuned up so that they were all at the wheel and could take care of the variation in the load, even supposing you could start out with a good regulation, you might possibly be able to approximate constant speed. The synchronous motor is difficult to start. It is not as difficult as it used to be considered, but there is some trouble in starting it. It is a little more difficult operation than with the induction motor. If the load gets too great—about 160 per cent. overload is usually the breaking out point in most motors of the synchronous type—your motor stops and throws the circuit breakers, and has to be re-started. On the other hand, the induction motor has a slip of from 1 to 5 per cent. with constant voltage between "no load" and "full load." The large motor with a 2 per cent. slippage between no load and full load is a pretty delicate piece of apparatus. There is also the voltage fluctuation, which will give you a corresponding fluctuation in speed. The miners want constant speed, and for a quartz mill I agree with Mr. Scarfe, and am firmly of the conviction that the synchronous motor is the best piece of apparatus to use. It has its advantages, and so has the induction motor, and it is really a question of considering each particular case rather than taking the two motors in the abstract. The synchronous motor has done good work, and it went into Nevada County of necessity, largely because they had a high periodicity (133 cycles) and there were no large induction motors—nothing over forty-horsepower built for that frequency—and consequently they had to put them in; but since they have had the low periodicity they have come to the same conclusion, that there are places where the synchronous motor is better fitted, and there are places where the induction motor is better fitted, so now they have both types. I don't think Mr. Scarfe would like to see his entire system induction motors, or *vice versa*.

MR. SCARFE. Mr. Lee's remarks carry out my idea exactly in regard to that. I am not talking against the induction motor at all, but we have found in actual practice up there that the miner is so exacting as to speed that if you can do away with one-half of the trouble, or the chance of trouble, you will come near satisfying him.

THE PRESIDENT. He will be able to sleep better at night. If there is no further discussion, as it is pretty near lunch time, we will have an adjournment now until after lunch.

AFTERNOON SESSION.

The Secretary reads paper on "The Influence of Periodicity on Line Capacity," by W. F. Lamme.*

THE PRESIDENT. You have heard this paper read. It presents some novel features, and some that should be the subject of comment and discussion. Mr. Baum, what is your view? You have heard the paper read. Have you any comments to make, or any discussion to start?

MR. F. G. BAUM. I think this matter is and has been pretty well understood for a number of years. It seems, however, that every once in a while some one will get out a paper, four or five years after we have done something, and then the whole thing is claimed to be new. This matter of the different capacities of the power line, with different frequencies, was worked out ten or twenty years ago, and in every transmission line it has probably been taken into account. There are other things to take account of. It is merely a question of whether we want to deliver at a high frequency, and reconvert to the lower frequency, or transmitting the power we want at a low frequency and converting back to the higher. It depends on whether we want most of the power at a high or low frequency.

There is another question that comes in the capacity as stated at the different frequencies. Of course, taking the line alone, say compare thirty cycles with sixty cycles, the line capacity would be practically twice as great at thirty as at sixty cycles using the inductive drop as a basis. That, however, does not say anything about the size of the wire we must use. We would have to use twice the weight of copper if we were going to transmit twice the power, at the same percentage loss no matter what the frequency.

The line is not the only thing to take account of. We have the generator to consider, also the transformers, step-down and step-up, and the receiving apparatus. Lowering the frequency in the generator makes the generator heavier. Lowering the frequency in the step-up transformers makes them considerably heavier, more costly and less efficient. Lowering the frequency in the step-down transformer makes that more costly and heavier and the same for the small transformers. So these compensating features have to be taken account of. It is rather remarkable, I think, that Mr. Lamme and Mr. Lincoln should both argue those points which are generally understood and are simple and should leave out those points which are generally not understood, and which are not simple.

THE PRESIDENT. Mr. Lee, have you anything to say in the matter?

MR LEE. I can only reiterate what Mr. Baum says. He has given the matter a great deal more consideration than I have. A case of this kind came up quite recently. Probably all are more or less familiar with it. Montreal plants which now form as far as electric construction is concerned, one large company—it has been consolidated in one management—is a sixty-cycle plant. They recently, on account of a plant which was built at Shawinigan with a frequency of about twenty-five cycles, made a contract to buy power from the Shawinigan plant, and I think that whatever they have saved in their line losses, or line capacity, has been more than taken up, as regards investment, by the necessary frequency changers which they have had to put in. The fact is that you cannot run arc lamps on the low frequency, at twenty-five cycles, which this plant is, and incandescent lamps are very unsatisfactory. Isn't that so, Mr. Baum?

MR. BAUM. Below about thirty cycles.

MR. LEE. Below thirty cycles incandescent lamps are not satisfactory. Some years ago, your company, I believe, took up the matter of installing some capacity neutralizers, which were just for the purpose of cutting down or neutralizing the charging current. And when we take into consideration the fact that the transformers cost so very much more at thirty cycles than they do at sixty, and the necessity of transforming all the current, except that which is used through rotary converters, it is an open question whether there is any advantage unless the line is extremely long, or longer than any we have built so far, to go to the lower periodicity. In southern California, they compromised the matter and put in fifty cycles, and I think at fifty cycles they are no better off than we are up here at sixty.

MR. L. M. HANCOCK. One thing that might be mentioned in connection with this matter is that he considers the straightaway

*THE JOURNAL, Volume XIII, page 261, July, 1903.

line, two hundred miles, and taking it, I suppose, that the power house is situated in the mountains, and there is one system of lines reaching down to the most distant consumer, two hundred miles, and the bulk of the power is distributed at that distance, while in actual practice, this condition does not hold good. A large part of the power is distributed along the line, and as a general thing, different power houses are connected in with the system, so that the ultimate result is not the same, and the point that Mr. Baum raised in regard to the weight of the transformers and the generators, especially, at the power house end, means quite a good deal to the companies installing the power houses in the mountains, because transportation is a very serious item, and it is very seldom that the power houses are closer than thirty-five to forty miles from a railroad.

THE PRESIDENT. I would like to hear discussion on the matter of the low periodicity, in line with Mr. Lamme's paper; a power house situated, say two hundred miles from the point of distribution, with no lateral lines running in that length; in other words, all of the power being delivered at the end of the line, and no power taken off in transmission. What would be the effect? Can you discuss that, Mr. Hancock?

MR. HANCOCK. That was an item I mentioned, that he seems to consider that the whole of the power is transmitted two hundred miles.

THE PRESIDENT. Taking the view that it would all be delivered at the end of the two hundred miles.

MR. HANCOCK. Then the condition would come more nearly to what he described.

THE PRESIDENT. That is what I wanted to bring out—what the condition would be if all the power was delivered at the end of the line, and none delivered along the line.

THE SECRETARY. It seems to me that the inference from Mr. Lamme's paper is that you get the maximum efficiency from a line in a transmission system with a given voltage and with a given length of line and a given size of wire, when direct current is used for transmission purposes. In other words, when your periodicity is zero. As you increase the periodicity, the power transmission capacity of the line decreases, the ratio is perhaps, not really defined, but it is suggested in Mr. Lamme's paper. It seems to me that is the point that deserves consideration—what is the influence of periodicity on the power transmission capacity of a line under fixed conditions as to size of conductor, to voltage, and to length of transmission given the delivery of power at the end of a line.

MR. LEE. As Mr. Baum says, it has been very generally understood that the high frequency cuts down the transmission capacity of your line—the transmission ability of the line.

MR. HUTTON. In speaking of a line two hundred miles long, one of the things I should seriously consider is the question of regulation. It seems to me that where a line is of that length, and if it is the intention to do very much lighting, either incandescent or arc, the question of regulation is a very important one. Assuming that it is sixty cycles, it is much worse from the standpoint of regulation than at thirty. It would appear therefore that it would be better to use current for lighting which has been transformed through frequency changers, rotary converters, or motor generators. With sixty cycles, your regulation is very bad, and the more large motors with varying load you get on the circuit, the worse your condition becomes. It seems to me that if you are going to do an extraordinarily large lighting business, whereas sixty cycles would seem to be the best, from the financial standpoint, still when it comes to the question of giving a really good lighting service, you can do it a good deal better at the lower frequencies if delivered directly to the load and still better by the use of motor-generator sets.

MR. BAUM. There is one point in regard to the basis for the statement that the line at thirty cycles has a greater capacity than the line at sixty, that I don't think is understood, perhaps, as well as it ought to be. In saying that the line at thirty cycles has twice the capacity of the line at sixty cycles, basing the line capacity on the inductive drop, we don't mean the size of the wire would be the same; the size of the wire you would have to use would at thirty cycles be twice the size at sixty cycles. In other words, for thirty cycles to transmit twice the power that we would with sixty, we would have to have twice as much copper. I don't think that point is quite understood.

That comes from the way the basis of the calculation is made. It is made entirely with regard to the inductive drop over the line; the inductive drop is independent of the size of the wire within reasonable limits. It is based entirely on what we call the regulation of the line, as Mr. Hutton has just mentioned. Now, the regulation of the line is not all we are concerned about. We are concerned about the regulation of the entire system, from the water wheel to the customer. I believe it is generally considered that the transformer will not regulate as well at a low frequency, although the exact figures I am not able to give. Also, the generators, I believe, will not regulate quite so well. So there are compensating features. Although there is no doubt that a thirty-cycle system will regulate better than at sixty-cycles, it will not regulate twice as well; the difference will not be so much as that.

THE PRESIDENT. Then the idea that a layman would get from the paper, that with a given quantity of power to be delivered at sixty cycles and thirty cycles, twice the amount of power could be given with a given sized wire, is not correct; so that the carrying capacity of sixty cycles over a given size wire is really just as great with thirty cycles, or less?

MR. BAUM. The carrying capacity so far as the power loss over the line is concerned of a sixty-cycle line or one thousand cycles, would be just the same as thirty cycles. The difference comes in in the way they have stated this line capacity as limited by the inductive drop.

THE PRESIDENT. The advantage to be derived from a thirty-cycle would be the advantage of regulation more than anything else?

MR. BAUM. The advantage of regulation, pure and simple; nothing else.

THE PRESIDENT. Not the commercial economy in the construction of the pole lines?

MR. BAUM. It would come in constructing duplicate lines, if you put a limit on your regulation. Say you limit to a certain figure the regulation of your lines, then when one line carries a certain amount of power you have to duplicate it, and when that carries a certain amount of power you have to build more. With a thirty-cycle line the limit of capacity would be a little higher, but not twice as high, as stated. At the same time, you would have to increase the amount of copper in proportion to the increased power.

MR. BABCOCK. In my opinion, the real point of this paper has not been brought out in this discussion. It is stated in the paper, but I think it has been overlooked in the discussion: "The current can be applied directly to railway work." The Westinghouse company is working along the lines of an alternating current railway motor, and I understand from the reports that have been published, that they are limited to not more than two thousand alternations in those motors. The railway motor, of course, must conform to certain requirements that other motors do not, in the way of starting heavy loads, and not disturbing the line any more than is absolutely necessary. For that reason, the same class of motor that can be used for railway work can be applied to this variable speed work, such as hoisting and elevators, very nicely. I think Mr. Lamme is looking into the future with a view to the development of the railway situation, and that is the point that he wishes to make in his paper, that by means of lower frequencies it is possible to transmit power suitable for these different purposes economically. It seems to me, that point is of more importance than the energy question with him.

MR. HANCOCK. It seems to me the question ought to be looked at in a broader way than from just one standpoint, even

that of railroads, or of lighting, or of any one kind of work to be performed. The general work to be performed by the transmission companies of this coast at the present day has been very variable; that is, different kinds of work to be performed. So much goes to mining, so much to lighting, so much to dredger work, so much to flour mills, and so much to other industrial work—shops, and day load, and still other amounts of power to night load and railroad. The railroad is not the preponderating customer as yet, although if an attempt were made to handle all the railroads of the State it probably would be. But the thing must be looked at in a broad way, and we should consider all the questions that come into the discussion, from generator, transformer at each end, the customers scattered along the line, and the different kinds of work that each customer requires.

[Contributed by Mr. F. G. Baum after adjournment.]

In my extemporaneous remarks on Mr. Lammes' paper, I perhaps did not make myself thoroughly understood. I did not intend to convey that I advocated a high frequency, or that sixty cycles was better than a lower frequency. The point I wished to make was, that in discussing a question of frequency, which affects every piece of apparatus on the system, including generators and receiving apparatus, we must not limit the discussion to one point or part of the system.

Unquestionably, so far as the line itself is concerned, a frequency of thirty cycles, would be better than sixty cycles, and a frequency of zero would be better than either. But the fallacy of reasoning that the lower frequency is better for the transmission system becomes immediately evident if we pass to the transformers, where we find that the higher the frequency the smaller the weight and cost, and the greater the efficiency.

The question of the best frequency for the generators depends upon the speed with which they are to be driven. Low speed engines favor a low frequency. In water power plants, using high speed machines, the best frequency for the generators would probably be above thirty cycles.

Lowering the frequency of the system from sixty to thirty cycles, while it will reduce the inductive drop in the transmission line to one-half, the inductive drop in the transformers will be little different, and very probably, also, in the generators, and as the regulation of the system is dependent upon the total inductive drop, including generators, transformers and transmission lines, the gain in regulation would not be directly as to frequency, so that the gain in regulation or capacity, as measured by the inductive drop, would not be as favorable to the low cycle system as stated.

The frequency at which the transmission system is being operated will also be influenced by the use that is to be made of the power. A power company at the present time, in California at least, must sell a good proportion of its load to the small towns for lighting, etc. These towns are already equipped with sixty-cycle apparatus, and, as it would be impossible to operate most of the transformers at thirty cycles, or lower, the transmission company is forced to supply power at the higher frequency.

The paper rather conveys the idea that the advantage of a low frequency for the transmission line is a new principle, whereas, it has been recognized for years, and was taken account of in frequency of sixty cycles chosen for the present Pacific Coast plant. If an entire new system were to be laid out, say for 200 miles, and all the apparatus from generators to local distributing apparatus could be put in new, it is very probable a lower frequency than sixty cycles would be chosen, but if the power is to be used for a mixed load of motors and lamps, it is very probable that it would not be best to go below the frequency at which flickering of lamps can be noticed—this limit is about thirty cycles.

Of course, if practically all of the power is to be used for railroad work, and the manufacturers find it necessary to have a low frequency to operate their motors, then the frequency of the system would be fixed by the motors, but while the present induction motor for railroad work is operating at a frequency in the neighborhood of twenty cycles per second, it is not at all certain that the future alternating current railroad motor will be of this frequency.

As I said in a paper before the Association a year ago, if our lines are to increase in length until they reach 400 to 1000 miles, we must operate at a lower frequency than sixty cycles in order to reduce the reactance volts, and also on account of the natural periodicity of the line.

[Communicated after adjournment by Mr. W. F. Lamme, who was unavoidably absent from the convention.]

It was not the intention of the paper to cover the whole subject of a power plant for generating and transmitting energy, but the transmission feature alone was presented. However since the subjects of generating and transforming have been introduced we will discuss the same briefly.

Mr. Baum acknowledges, first, that with the same energy transmitted, the line regulation is better at lower than at higher frequencies. Second, that with lower frequency there is a commercial economy in the pole line construction.

It is therefore unnecessary to discuss the two points above. The questions in doubt are those concerning generators and transformers. At twenty-five cycles a large generator is no heavier than one built for sixty cycles and it is not more expensive, in spite of a prevailing opinion to the contrary. This is due to the mechanical requirements. A generator of large size must be well supplied with material to make it solid and rigid, whether of twenty-five or of sixty cycles.

On a transmission system such as we find here in California, the generator regulation is much better at twenty-five cycles than at sixty cycles; this is due to the difference in charging current and the inductance, both of which react upon the generator. We hear of charging current neutralizers for sixty cycles, which, while not to be advocated as good engineering, still can be applied to twenty-five cycles as well as sixty cycles, which will make the twenty-five cycles still better as regards regulation than it is without the use of the neutralizer.

As to transformers:

Weight—Transformers on twenty-five cycles are slightly heavier than at sixty cycles.

Expense—Transformers on twenty-five cycles are slightly more expensive than at sixty cycles, say 5 to 8 per cent. more expensive.

Regulation—At twenty-five cycles, and all in lighting loads, the transformer regulation is not quite so good as at sixty cycles, from ½ to 1 per cent. in small sizes, to .1 to .2 per cent. in large sizes. With 90 per cent. power factor the two cycles nearly agree in regulation, and with 80 to 85 per cent. power factor the regulation is in favor of the twenty-five cycles.

With a load consisting of half in lights and half in induction motors, so far as transformers are concerned, the regulation is not much different.

Mr. Hancock says I have cited a specific example, but that if the power is distributed along the line, which line is fed from a number of power houses, the case is different, due chiefly to weights of generators and transformers. As stated before, the generators at twenty-five cycles are no heavier than at sixty cycles, the transformers are slightly heavier, say 8 to 10 per cent. In the remarks above, the question of regulation is discussed, and from them we see that except for arc lighting, twenty-five cycles would be much better suited to a system distributing light and power along the line than one of sixty cycles for the reason that the voltage at the distant portion would be nearer that at the close portion of the line.

Incandescent lighting is a commercial success at twenty-five cycles. Niagara City is using twenty-five cycles for incandescent lighting.

In the works of the Westinghouse Electric and Manufacturing Company at East Pittsburg, incandescent lights at twenty-five cycles have been used since 1894, and in the draughting room, where illuminating requirements are rather severe, no inconvenience has ever been experienced from its use. Twenty-five cycles is already established as a commercial success. As a suggestion

and to avoid the use of revolving machinery, we could use the 300 to 500 candle-power Nernst lamp in place of the present arc light. This would be but little more expensive in current and would save the expense of frequent trimming of arc lamps.

In the presentation of this paper no particular system has been held in view, but the subject is treated as simply and as generally as possible. Nothing new is claimed for the paper, but it was presented as one fruitful in discussion.

THE PRESIDENT. I regret that Mr. Lamme is not here to discuss the thing a little bit further. If there is no further discussion on this paper we will have Mr. Holberton's paper on "The Local Distribution of Polyphase Currents."

[Mr. Geo. C. Holberton reads paper.*]

THE PRESIDENT. You have heard the paper. He says he hopes it will invite discussion, and it should. There are a number of different subjects he has touched upon, all in the same line. Is there anyone who wants to discuss it?

MR. HUTTON. One thing to which I want to draw your attention particularly in Mr. Holberton's paper is the question of having automatic voltage regulators in the substations. Mr. Holberton states that one objection to those automatic regulators is their cost. In the first place, you have to have a regulator of some sort if you are going to have regulation, and if it is going to be taken care of by hand, it has got to have a crank and a hand-wheel on it, and all that is really necessary to make this thing entirely automatic is to have either your pilot circuit coming in from the center of distribution, or the compensated circuit arrangement, which can be used just as well, and connect the same to a relay, and thus make the regulator entirely automatic. The question of regulation on a long line is something that is very uneven, and it is next to impossible to have anyone operate the thing by hand and have it kept anywhere near right. It is just about the same proposition as trying to operate a water wheel and do hand governing. It is out of the question. Wherever you can get a machine to do the work that you are supposed to do by hand, the results are always very much better, and the money saved by doing away with hand operation will pay the interest on a very large investment in automatic regulation.

MR. VAN NORDEN. I was going to ask Mr. Holberton if he spoke in his paper about the advisability of putting the regulators in oil. It also brings up the point that it is better to leave the regulator to be used simply to make changes as changes of load came on. Do I understand that the oil regulator would obviate the damage through sparking?

MR. HOLBERTON. That is what we found. We have had several of the first type air-brake regulators, and we began to get letters in from the different substations that the clips had burned up; sometimes they had melted altogether. We had that in our feeder regulations in Oakland, and we found trouble in sparking at the clip. Since that time we have installed a great many where we have taken the regulators off and put them in a bath of oil, and the trouble has been obviated altogether. In San Rafael they are working them all the time and have not had any trouble. When it is immersed in oil, the dirt can't get in. The oil serves to constantly lubricate.

MR. LEE. The advantage of the oil regulator as against the air or open type is, I think, just the same as the advantage of the oil switch as compared to the open or knife type of switch. It is nothing more nor less than an oil switch, and the oil regulator development has followed the development of the oil switch. Before we had oil switches, we didn't have any oil regulator heads. In most types of regulators it is a very simple matter to put them in oil. I have converted a number of them. The question of the use of an automatic device is one for the general manager of the power plant, or the gentleman who passes upon the appropriation to decide upon, *i. e.*, it is simply a question of expense.

MR. HANCOCK. Mr. President, Mr. Holberton omitted, and I was very much in hopes he would touch on it, the question of getting from the voltage of the line transmission to the system for distribution. In other words, the majority of the transmission companies transmit three-phase. Then is it advisable to distribute at three-phase? If so, at what voltage? Is it advisable to transmit at two-phase, and if so at what voltage, and how far out in your system shall you carry that idea, whether you carry your three-phase to the extremes of your plant, or whether you feed from your substation at single-phase?

MR. BABCOCK. For the purpose of opening the discussion along that line, I will state that in my opinion the local conditions determine that point. The two-phase distribution was chosen in Petaluma, Santa Rosa and Napa for the reason that it is easier to handle two circuits than three, and keep them balanced, and we can get two-phase motors just as well as three-phase motors. The distances were short, so that the size of wire was more often determined by mechanical considerations than by the electric load. In San Rafael and this district the question was entirely different. There was an isolated load, practically speaking, at Belvedere and Tiburon, of some 3000 lights; in Sausalito about 2500 lights; in Mill Valley somewhere about 3000 lights; that is to say, those are the loads that we estimated there. To run at, say two-phase, 2000 volts, such as we did in other sections, would have made the copper come pretty high. For that reason we chose the 4000, three-phase, with, if I remember correctly, three-wire, 200 volts secondary. While the advantages of the 4000 volts, three-phase, are very large along these lines, there are disadvantages along other lines. We had our wires burned off by pieces of bark of gum trees being blown across the line. I don't think the lines are quite far enough apart—they get together too frequently. A 4000-volt line should be built differently from a 2000-volt line. It does not seem to me that the advantages are all in favor of the three-phase 4000-volt circuit, even for those districts. The line troubles are more frequent than they ought to be. But those are the reasons for making the voltages what they are in this district, and I will be very glad to see discussion on those specific cases.

MR. VAN NORDEN. I would like to ask Mr. Babcock, or in fact anybody who has had experience in that line, about two-phase distribution in which the phases were tied together, either at the central point, or irregularly, where the four-wire, two-phase were tied together.

MR. BABCOCK. I have had no experience with such lines. The two-phase system in Petaluma, Napa and Santa Rosa are really two independent phases, but owing to the peculiarity of the method of transforming from three-phase to two-phase, the two-phases are actually connected electrically on account of the transformer connections, but I don't think there have been any connections made in the manner Mr. Van Norden mentions.

MR. HOLBERTON. There is another consideration that has not been given to that subject, which applies not only to this but to Mr. Lamme's paper. That is the business consideration. There are reasons for not doing some of these things which technically sound all right, but are matters for the management to take up. For instance, the way things are going the companies are all becoming more or less tied in; that is, the district they are covering is so great that they are, in many instances, in the same territory, and it seems to me a great deal better to try to get some compromise arrangement which will suit them all, so that they can help each other out in time of trouble, and also to enable the consumer to use the same apparatus on either system. That question comes up in the matter of local distribution. If you have fifteen or twenty different companies, and every one is a different system, it means a harder matter in the purchase of supplies and motors for the different ones. So I think these considerations will sometimes outweigh the question of technicality in engineering.

MR. HUTTON. There is one point Mr. Holberton brought up in regard to the 200-volt lamps. I would like to know just what success they have had in the matter of efficiency in making the 200-volt lamp as compared with the 115 or 120?

MR. HOLBERTON. We have not had any complaints from any-

*THE JOURNAL, Volume XIII, page 265, July, 1903.

body on the subject. It is a fact that in the 200-volt lamp we generally use a four-watt lamp, where we would use on 110 volts in our heavy district a 3.5-watt lamp, and we use about a 3.5-watt lamp where we would use a 3.1-watt lamp on the other service. But as a rule we use it in outlying districts, and that percentage added to a residence bill does not amount to very much.

MR. HUTTON. About 10 per cent. If his bill was $2, it would be $2.20.

MR. HOLBERTON. A man does not notice that, whether it is $2 or $2.20. We don't make any distinction in selling the lamps to the consumer, whether it is a 110-volt lamp or 220-volt lamp. They cost us a little bit more, but that is made up on the saving of transformers and copper.

MR. BABCOCK. One point Mr. Holberton brought up that I don't think he goes quite far enough in—that is the question of having secondary circuits for the instruments, on the boards. When you gentlemen go to the North Shore power house to-morrow, you will see a 4000-volt board without any 4000-volt wiring. There are only secondary circuits on that board, and according to my mind this is the way the board should be handled. I think that all recent switchboard work indicates that in future you will have no primary switches on your boards; no high potential wiring on your boards; nothing but secondary circuits.

MR. RAY. I have watched the distribution of electric power and light during the last seven years or so in many different ways, and have seen the low potential systems grow from our old fifty-volt system to the present 220-volt system, and have seen the amount of money that has been, as you might say, wasted in one way, in the old systems in California, and it seems to me that to-day no central station manager, or central station engineer should develop a system which is not capable of extension to at least four times its present capacity without a great expenditure of money. Today it seems to me that if a man installs an ordinary 2000-volt system, and tries to take care of a certain amount of load, it is only a matter of three or four years before his investment will have to be duplicated, and may be made three or four times as large as at present, and I am, for one, a great advocate of all of our distributing systems being installed on the basis of four wires 2000-4000 volts, so that as our business grows we can take care of that business without remodeling and without changing, and it seems to me that the additional expense of 200-volt installations at the present time is the greatest economy in the end. From my personal experience in two-phase distributing systems, it seems to me that there are very few towns where it would pay at the present time to install a two-phase distributing system, where the town was over six or seven thousand population, unless it was very favorably located for the distributing lines. Our business is growing we are reaching out into new territory, and we must be able to extend without sacrificing our present investment, and I think the 220-440 volt secondary distribution and 2000-4000 volt primary distribution are the only things that should be carried on at present. I think Mr. Holberton's distributing system shows that to very good advantage.

MR. BIBBINS. I want to say in regard to incandescent lamps, that it is only a question of demand but what all the 200 volt lamps can be procured at practically the same price as the 110. It is more a question of market than any other. In regard to the 220-volt secondaries there is one obstacle that will be confronted and that is the question of arc lamps. There is not a suitable 220-volt arc lamp on the market, and there does not seem to be any prospect for one. At the present time the great trouble is in the arc; too much violet rays. It seems to me that is a serious consideration but of course this obstacle can be overcome by the use of compensators—two lamps, or one lamp on the compensator. That means an additional expense which you would not have to incur in the case of 110 volts; and in some installations, say in San Francisco or Stockton, where the multiple arc lamp service is considerable, it would cut some figure in the expense.

MR. HUTTON. I would like to ask Mr. Bibbins if there is any good reason that he knows of why it is that a 220-volt multiple arc lamp could not be developed by simply putting a larger reactance in the lamp than they do now. For instance, across the arc you get about seventy volts, and across the reactence coil about eighty volts. If that was made larger you could have the same amperage and the same voltage across the arc, and the extra consumption would be practically wattless. Has anything been done in the way of developing a high voltage, multiple, alternating current lamp in that way?

MR. BIBBINS. I think there has. In fact, I know there has. As I understand the matter it is largely a question of power factor there. You will get a very low power factor in the lamp. I know a great deal of work has been done in the General Electric arc lamp factories on that line. The 220-volt alternating lamp has been designed, but it has been discarded as uncommercial.

MR. HUTTON. That is, on account of the power factor.

MR. BIBBINS. That is one of the reasons. I don't understand the whole thing fully.

MR. HUTTON. If, and it undoubtedly is, a question of power factor, wouldn't it be possible to develop an economical condenser to use with the lamps. For instance, suppose you have a number of arc lamps installed for lighting a large store, say fifty to sixty. The condenser would, perhaps, have to be supplied by a step-up transformer to bring the cost of the installation down, but it seems to me that as long as there are so many advantages in using 220-volt lamps, it would almost pay to do that and get the advantage of not having to consider the question of power factor in multiple arc lighting. You could then use the 220-volt system, and still have your arc lamps.

MR. BIBBINS. I should think in a case like that you would best take care of it by connecting it up on 110, with a separate transformer for that installation.

MR. P. C. BUTTE. There is a 220-volt arc lamp, and there has been a good deal of dissatisfaction with it owing to the color of the arc itself. We find that the arc forms a very blue color, and this is extremely objectionable in interior lighting. There is a system in which they run two arcs in series, and it has been introduced to some extent in the East, but they find a certain objection to that, in that they find that, as one of the speakers has suggested, in putting a choke across the lamp, it reduces the power factor of the system, and that is very bad on any system. But there is a system where they have put two lamps in series, with a choke on top. In case one lamp is cut out, or happens to go out, the choke is cut in automatically, and in that respect their lamp is going all the time.

MR. JOHN MARTIN. It occurs to me, after listening to some of the remarks made by previous speakers, that the wise thing to do would be to have a committee appointed to report at our next annual meeting recommending a standard condition for distribution, and I will move you that a committee of five engineers of the various companies be appointed by the president for the purpose of reporting at the next meeting to that effect.

THE PRESIDENT. That will be taken up at the executive meeting.

MR. BAUM. There is one question in regard to changing from three-phase to two-phase that has not been touched upon. In changing from a three-phase to a two-phase system by transformers, or from two-phase to three-phase you always lose a certain percentage of your transformer capacity, say somewhere around 10 or 15 per cent. In the ordinary substations this would mean 10 or 15 per cent. on two or three thousand dollars, and that amounts to something. In the East I think at the present time, all the work is going in three-phase 4000 volts, that is, 2300 Y. I think the experience there might mean something to us out here.

THE PRESIDENT. If there is no further discussion on this paper we will proceed to the reading of the paper by Mr. H. A. Bullard on "Single-Phase Motors on Polyphase Systems."

[Mr. Bullard reads paper.*]

*THE JOURNAL, Volume XIII, page 258, July, 1903.

THE PRESIDENT. You have heard Mr. Bullard's paper. I hope it will bring forth some discussion.

MR. HANCOCK. I would like to inquire what size motors are available, and what are in service; what are the largest sizes? Are they all small, or can you secure motors up to 50 and 75 and 100 horsepower?

MR. BULLARD. At the present the largest size which we have or intend to carry in stock is 40 horsepower. We had an order only a few days ago for three of 50 horsepower, and had to refuse it on account of the limit in size which has been established. I didn't want to bring that element into the meeting, any more than to answer the question. The majority of motors which are now in use run from 1 horsepower to about 7½. Above that we have quite a number in use running up to 20 and 25 and 30 horsepower.

THE PRESIDENT. You have no 40-horsepower motors in service?

MR. BULLARD. Not on the coast. East we have.

THE PRESIDENT. For what length of time have they been in service?

MR. BULLARD. Those have been in service, I should say, as much as three years.

THE PRESIDENT. So they have passed the experimental stage?

MR. BULLARD. Yes.

MR. HOLBERTON. We are using in Oakland up to 10 horsepower. We have probably twenty or twenty-five motors at that. They have some advantages which have not been mentioned. It is not only a question of the number of transformers and all that, but it often happens that a man has a service on his premises, and he wants one or two horsepower to pump water, and it saves running another phase. We have them, and so far we have not burned out any, and have had very good success.

MR. RAY. I have listened with a great deal of pleasure to Mr. Bullard's paper. It seems to me it opens up a great field for many of our transmission companies. In many transmission companies using polyphase systems we can afford to run a lighting circuit for two or three miles to take care of lighting business only, while it would be almost prohibitive to run polyphase circuits that distance, and while we have a single-phase lighting circuit small motors can be connected on, and it is a great source of income, because nearly all the small motors will be operated in the day, and the power company absolutely does not have to invest a dollar. That is one of the great advantages of the single-phase motor, in that we do not have to invest any money to run a great many power circuits. We can use our same lighting circuits for it, and it seems to me that it also presents a side which is of considerable importance to the average transmission company. That is, a transmission company running through a country seventy-five or 100 miles, passes a great many small towns, of from 300 to 500 people. If we can put in a single transformer and furnish those people with a lighting service, and do a small amount of power business on single-phase circuits in those towns, we may make a great many friends for our transmission company. In other words, the transmission companies are utilizing the public highways and getting rights of way from the public for their lines, and if we cannot in some way be useful to the general public, we stand as a detriment rather than as a benefit. This, it seems to me, is one of the great advantages that the single-phase motor offers to us. It enables us to get into a new field which we cannot get into profitably with two-phase or three-phase work.

MR. WILLIAM ANGUS. Like some others, my experience with single-phase motors is six or eight years old. We operate a three-phase system, and I have been asked to employ single-phase motors on our lines. With our three-phase work for either lighting or power we have no trouble in regulation, and our motors have never given any trouble. Our district is very scattered, and I am fearful about putting on single-phase motors, because of the experience I have had with them in the past. Six or eight years ago they were a continual trouble and were being thrown out. If any gentlemen have operated them on these scattered lines, I would like to know what their experience has been. I do not want to put anything on the system that will upset the present good regulation which we have.

MR. H. H. NOBLE. I will say that up north, at Corning, and in that country, where it is very much scattered, we have a three-phase system on which we operate quite a large number of single-phase motors. These give good satisfaction, and, in fact, our manager up there recommends them for all small work. We are not fortunate enough to have any very large work in those towns; but for small motors he has recommended them in every instance, and in every case they have given excellent satisfaction.

MR. LOW. Are they recommended over two-phase and three-phase motors for small work?

MR. NOBLE. Yes; he has done so on account of cheapness. There is less transformer capacity. In some towns we only have one transformer. So that there has been a great saving in that respect. The towns are very small.

THE PRESIDENT. Are any single-phase motors used at Sacramento?

MR. VAN NORDEN. We have two or three of them in Sacramento, very small ones, but we have a local line in which we had some call for power, and, necessarily, we were obliged to put on single-phase motors. We have a line in which our transformer capacity is about thirty-seven kilowatts—the transformer at the power station—and the line supplies several small towns, and the largest motor we have on it is 7½ horsepower, and the satisfaction we have had is enough—the motors have made no trouble, and we consider them very satisfactory. We have never noticed any fluctuation in our lighting, and they have run in many cases at night. We have one particular case where there is a private line to light up a sort of summer villa that is two or three miles from the line, in which a single-phase line was put in purely for lighting, with the transformer at the point for the capacity of the lighting of the house. The man that runs the place wanted to pump water, and so he put a single-phase motor right on there without either increasing the transformer capacity or interfering with his lights, and we find it very successful. In small towns we have but two or three places where we have very small motors and did not wish to run extra primary lines, so we had single lines, and there we use single-phase motors, and we find them satisfactory.

THE PRESIDENT. The inference would be, unless somebody has had experience to the contrary, answering Mr. Angus' inquiry, that single-phase motors as operated on the Pacific Coast, have been entirely satisfactory.

MR. HUTTON. It would seem to me that some of the trouble that Mr. Angus had in his circuit might be due to the fact that, as he says, he has a three-phase circuit, and that circuit might be installed for a given regulation. If he put, for instance, a 10-horsepower single-phase motor on that three-phase circuit, even though it might not take over 25 per cent. normal running current to start, that motor would affect the regulation of the line about the same as a 20-horspower three-phase motor would effect it. So it seems to me that some of his trouble from regulation and disturbance might be due to that fact. It seems to me that if a distributing system was laid out as a polyphase system with a given capacity, it would not be advisable to use single-phase motors of any very great size. They might be a small percentage of the total. But it doesn't seem to me that it would be very advisable to put on anything as large as a 40-horsepower motor, for the reason that the three-phase circuit would practically have to carry the same current to start it up (that is to say, the effect on the regulation would be about the same) as starting a 75 horsepower three-phase motor.

MR. BABCOCK. One point stated that has been lost sight of is the cost of the transformers for the work Mr. Angus suggests. He is using a 4000-volt three-phase system.

MR. ANGUS. Four thousand primary.

MR. BABCOCK. Unless the neutral is carried out, it means that

the transformers for these single-phase motors must be more than 4000 volts primary; and I don't understand that that is a commercial transformer except at an increased cost, very much greater than the 2000 volts primary. In the case that Mr. Ray brought up of tapping the transmission line for a small town of some 300 to 500 people, he would run into the same difficulty there. I doubt that it would be possible to operate a transformer of any capacity with a ground, as that has been shown in the experience on the 40,000-volt line in this district. In case of one primary fuse blowing out, the triangle would be maintained as long as the load is not sufficient to overload the ground connection. The minute the ground resistance of the circuit becomes too high, the triangle falls flat, and your transformers will go into series. So I think Mr. Ray would be obliged to use a 40,000-volt primary on his transformer, which would add very materially to its cost.

MR. RAY. We cannot install large systems that way, but it seems to me it affords an opportunity for furnishing satisfactorily a great many small territories that we cannot furnish otherwise. At the present time we have on the Bay Counties system one transformer from the main 40,000-volt line which is giving very satisfactory results, and is carrying a load of about thirty-five kilowatts, and carrying some single-phase power motors of small size; and it seems to me that where we can get installations of that size it is a very paying proposition, and while it may not be feasible to install single-phase units of 150 horsepower on polyphase systems, yet in small units it would seem to me to be advisable to serve that small population and keep friends with the public.

THE PRESIDENT. If there is no further discussion we will proceed with the reading of the next paper.

[Mr. L. M. Hancock reads paper on "The Engineering Organization of a Transmission Company."*]

THE PRESIDENT. You have heard the paper read by Mr. Hancock. Is there any discussion on the matter, or are there any questions that any one would like to ask him?

MR. JOHN MARTIN. Mr. Harter might give us some points on how to enthuse.

MR. R. L. HARTER. I don't know any better way than to get them up against a hot telephone line, or something of that kind. The main thing with a patrolman is to get enthusiasm up at the right time, before there is any trouble. This occurs in looking out and preventing trouble and foreseeing where trouble would be. They don't know what to look for unlesss they have had experience, and what we are supposed to do is to gather experience from one end of the line to the other and communicate that to each patrolman, giving him object lessons, if we can, and educate him in a way that he will be able to prevent trouble and give us the true conditions. The most valuable patrolman is not the man who knows the most things, but who observes and keeps himself posted and who gives you the facts as he finds them. That is the experience I have had with patrolmen.

THE PRESIDENT. If there is no further discussion we will proceed to the reading of a paper by Mr. P. C. Butte on "Alternating Current and Direct Current Arcs in Street Lighting Service."

[Mr. Butte reads paper.†]

THE PRESIDENT. You have heard Mr. Butte's able paper. Is there any discussion on the matter?

MR. ANGUS. The one thing in the paper that interests me is the question of 2000 candle power in lamps. We have several small communities, and the chairman of the Board of Trustees took it on himself to make a test of the arc lighting system. I have not heard the result of the test, but he is not going to get 2000 candle power. It is a misnomer and is liable to lead to useless discussions between boards of trustees and companies. They give contracts discussion enough without having to bring up the question of candle power.

THE PRESIDENT. One of the members of the Board of Supervisors of Nevada County, in a discussion with me, asked whether 2000 miners' candles put on top of a lamp would not give more light. The only answer he ever got was, "Let them get up on top of the pole and hold 2000 candles and they would see." That is the way the discussion remained. I think I will appoint Mr. Angus a committee of one to decide the question with him. If there is no discussion we will proceed to the reading of Mr. Babcock's paper.

[Mr. A. H. Babcock reads paper.*]

MR. H. D. SCRIBNER. It seems to me that the point that Mr. Babcock brought up there, that they are going to parallel the steam lines, is well taken, and that the transmission companies must look for their future business in railroad lines.

THE PRESIDENT. I think you might qualify that by saying a portion of their future business.

MR. SCRIBNER. A portion; but they are all looking for business.

MR. VAN NORDEN. I would like to ask what the record has been for accidents and interruptions, due to the third rail.

MR. BABCOCK. Those points I went into some length last summer. I visited the Muskegon line after it had been in operation two months. The superintendent told me that the line had been shut down twice by boys putting wires across the third rail and the track. The first time the boy got away, but the second time they got the boy. He was so badly burned that he was in the hospital for some weeks. That ended the interference from those fellows. Once a cow got on the track, short-circuited itself and became beef. The company had to pay for her. They catch all the stray dogs, cats and skunks. I think that possibly is some advantage.

MR. NOBLE. And rattlesnakes?

MR. BABCOCK. I don't think they get that high. On the New York, New Haven and Hartford line they have had two accidents, one a fatal one. The conductor of a freight train tripped over something and fell across the third rail in such a way that it paralyzed his heart. He was known to have a weak heart. There was a sensational story in a newspaper about a woman carrying a child; her skirts caught in the track and she and the child were burned. I wrote to Colonel Heft of that road for particulars. He replied that the child was not injured and that the woman was not burned very badly.

The trouble on the elevated has been caused largely by wires falling across the track from the breaking of the telephone and electric light wires in heavy storms, and by ice gathering on the rails. I do not anticipate any serious shutdown from those causes.

MR. VAN NORDEN. I had reference especially to the shutting down of the lines, more than to the cause of danger to the people.

MR. BABCOCK. By reason of short circuits?

MR. VAN NORDEN. Yes.

MR. BABCOCK. That occurs very seldom. It generally burns off the end of the tie and the insulator will drop clear. The third rail is not fast to the insulators. It rests between the clips. If the insulator burns it drops clear, and the other two insulators on each side carry the rail. There has been some trouble with the underground connections, but I hope to obviate that by our method of putting them in. I have a record of a test on the Albany and Hudson, where 900 feet of the third rail was under water and the total leakage was 140 amperes. Under the worst conditions, in a heavy storm, the average leakage would be from thirty to fifty milliamperes per mile. The question that Mr. Lamme brought up in his paper seems to me important to transmission companies. I feel that the development of an alternating current railway motor is not very many years off. Once that it is done, it will put into the hands of the railway manager a means of reaching out to tremendous distances, and the transmission companies will either have to supply direct currents at

*THE JOURNAL, Volume XIII, page 263, July, 1903.

†THE JOURNAL, Volume XIII, page 261, August, 1903.

rates which will compete—which they may be able to do, owing to their paralleling these trunk lines—or they will have to change their frequency in some way or other to meet these conditions. Mr. Arnold, in the East, is working on the same line; also the General Electric Company, I understand, is working on the same line, and the Westinghouse Company promises great things.

MR. NOBLE. Isn't there an alternating current road being built now?

MR. SCRIBNER. The Westinghouse Company is equipping a road between Baltimore and Washington, with a branch running to Annapolis. It will be placed in operation this summer, but they are rather chary about giving details until they work out a few of the bugs. The motors are on test, however, and the generating station machinery is being put in position.

MR. R. B. DAGGETT. I would like to mention a point in Mr. Babcock's paper about equipping substations. He states that some reserve must be provided, as the transmission men all know, and he recommends a gas engine or gas producer—a tank for storing gas for an hour—and says that batteries probably would not be useful, as their cost would be too high. Of course, in order to establish continuous service the battery would be necessary. Probably a gas engine would be able to be started up in five or ten minutes, which possibly would be well enough for some interurban service. He also states that he would equip the substation with two motor generators, or rotary transformers, as the case might be, each one of sufficient capacity to take the maximum load, I would suggest as a modification of that plan, putting in one motor generator or rotary transformer of sufficient capacity to meet the average demands, which would be at least one-half or perhaps one-third of the maximum load. Mr. Babcock stated that the starting load would be 100 per cent. increase over the average load for one car. Taking into consideration the stops, etc., the average load would probably be something less than 50 per cent. of the maximum. This motor generator of average capacity with the battery would take care of the load at all times. In case of a shut-down on the entire system the battery would operate the road for say two hours. It would then be possible to equip at the center of distribution—some central station—with a gas engine of sufficient capacity to carry the average load of all the substations. This would probably be one-third of the capacity of all the gas engines installed, and this gas engine, instead of having a gas producer, could be started from crude oil, the gases being generated by the heat from the exhaust gases of the engine. This would somewhat reduce the cost of operation of the gas engine. I believe that the total cost of equipment of the road would not be any more than in the case cited by Mr. Babcock, but, of course, I have not had time to go into the figures of equipping with the other devices. Another point is that most of these railroad systems are at the end of some long-distance transmission system, which supplies current also for lights, and it is quite necessary, according to the papers that have already been read, to have perfect ventilation. If the batteries are installed on the system, that gives a perfect regulation and you will have good service all the time. If Mr. Babcock will take up the figures, I should like to go into the matter with him.

MR. BABCOCK. I may not have made the point altogether clear. Mr. Daggett has misunderstood it, at least. I would not equip the substations with gas plants. That would add tremendously to the cost of the road, and to my mind is not the correct way at all. I would equip a central point with a reserve that would handle the whole thing. What that reserve would be would depend upon the conditions existing at the time. I don't think it would be a battery, for the reasons that I have given. It will be some prime mover to drive machines that we already have. It has been my experience that if you make the system large enough the load factor will be very high, and with these interurban cars running at high speed and not making many stops—which they cannot do, by reason of the service they perform—your load factor will be high. I don't think that the battery is necessary to smooth off the peaks, and I still adhere to my opinion—it is an old point between Mr. Daggett and myself—that a battery is too expensive for that class of service. He asks for the figures. He and I have gone over the figures many times together, and I would be very glad to take them up at any time in the future, because I am open to conviction, but I don't think I can do it here.

THE PRESIDENT. Mr. Babcock thinks that batteries will be very much cheaper in the future. We hope so.

[The secretary then read the following report of the committee appointed at the last session in the matter of resuscitating persons injured by electric shock.]

Report of the Committee on Resuscitation from Electric Shock:

There has been no meeting of the Committee on Resuscitation from Electric Shock because of the departure of Mr. Poole for Colorado and the long absences of both Mr. Doble and the undersigned from San Francisco. As chairman of the committee, however, the writer would state that he has made careful inquiry in every section of the country in which he has been during the past year into both ideas and experiences along the line indicated. As a result, the writer does not believe it possible to improve upon the set of rules published in the *Electrical World and Engineer* of September 6, 1902, Volume XL, page 353, and recommends their endorsement by the Association, with the proviso that there be added thereto a clause suggesting to station managers that station attendants, linemen and others, as necessary, be required to go through a resuscitation drill at stated periods of not less than six months apart. E. E. STARK.

MR. HUTTON. At the last meeting of the National Electric Light Association a paper was read by an eminent physician whose name I cannot recall on the subject of shocks and resuscitations, in which he made a number of recommendations. One of them was that each generating and substation and all vehicles used by the companies be equipped with a little chest, in which would be quite a number of small appliances—bandages and salves and things of that sort—that would be useful for the alleviation of pain from shocks and burns. It seems to me that it would be a good idea to get a copy of that, together with this other one that we have and incorporate them together, and arrange in some way for the transmission companies to be furnished with them. I make a motion to that effect.

THE PRESIDENT. At the suggestion of the secretary, as Mr. Poole, who is on the committee, is not with us any more, I suggest placing Mr. Hutton on the committee, in place of Mr. Poole, and that Mr. Hutton's suggestion, and the report, be referred back to the committee for further action.

[It was so ordered.]

[Adjourned until 8 o'clock P. M.]

MAINTENANCE BUREAU.

THE Nernst Lamp Company, of Pittsburgh, Pa., has established a Maintenance Bureau for the purpose of supplying users of Nernst lamps with new burners or holders, so it will not be necessary for the customer to visit or call upon the electric light stations when one of his lamps gives out.

The Maintenance Bureau makes a contract to supply to its customers a certain number of extra holders which are kept in a box especially made for this purpose. He simply takes one of these extra holders and replaces the old one with it, returning the old holder to the box, which is called for by a messenger attached to the Maintenance Bureau. This messenger takes the burned out holders to the Bureau and they are refilled and returned to the customer. The taking out and putting in of these holders is as easily accomplished as the changing of incandescent lamps. By this method, the users of Nernst lamps are not put to the inconvenience of notifying the electric light company when the lamp gives out; thus avoiding the necessary delay in having their lamps renewed.

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SPECIAL NOTICE.

The attention of our readers and advertisers is called to the removal of the office of "The Journal" from 144 Union Square Avenue to Room 302 Rialto Building, San Francisco.

ALL communications, whether to the editor or to the manager, should be directed to the JOURNAL OF ELECTRICITY PUBLISHING COMPANY at the new address.

EDITORIAL.

TANGENTIAL WATER WHEEL EFFICIENCIES

In last month's JOURNAL it was announced that Geo. J. Henry Jr.'s paper on Tangential Water Wheel Efficiencies would form the leading article in this issue, but unfortunately the paper, illustrations accompanying it, and the resulting discussion, could not be revised in time, and had to be postponed for a future number.

This paper together with the exhibit and discussion following same, formed one of the most interesting features of the last convention of the Pacific Coast Electric Transmission Association, and it is with much regret that THE JOURNAL announces its postponement.

This announcement is made in response to the numerous inquiries received by our business office, for copies of the edition covering this interesting topic, and as soon as the paper appears orders for these extra copies will be promptly filled. In the meantime the balance of the papers and discussion of the Pacific Coast Electric Transmission Association appear in this number.

PACIFIC COAST GAS ASSOCIATION CONVENTION

The most important feature in the engineering field during the past month, was the Eleventh Annual Meeting of the Pacific Coast Gas Association, which was held at the offices of the Pacific Gas Improvement Company, on Tuesday and Wednesday, the 21st and 22nd of July. Thursday the 23rd, was given over to an outing in the form of a trolley car party to points of interest in this city, which embraced one hour's relaxation for luncheon at the Cliff House.

Never before in the history of the gas association has so much interest been manifested as at this meeting, nor has the attendance heretofore been nearly as large. This is extremely gratifying to the members and also demonstrates the growing interest manifested by the members. The meeting was called to order on Tuesday morning, July 21st and sixty-four members responded to their names at roll call. The report of J. B. Grimwood, secretary and treasurer, was read, showing the finances of the association to be in a healthy condition with a good balance on the credit side, after all expenses of the current meeting had been paid. Mr. Grimwood's report shows also that while a considerable sum of money had been spent by the library committee in the purchase of books, there were still funds on hand to the credit of this department.

After the directors' report was read and adopted, the library committee reported gratifying progress during the past year. The frequent calls and inquiries for books of reference on special subjects, demonstrated that the library was filling a need of the Association and it was found necessary to publish a catalogue of the works on hand.

The Association is indebted to J. B. Grimwood for the design and contribution of the book plate, which is an artistic reminder to members that the books should be returned to the library after they have been used.

The following new members were elected: Philo Jones, superintendent Salinas Water, Light and Power Company, Salinas, Cal.; Robert J. Thompson, San Francisco; A. J. P. Matthiesen, San Francisco; Franklin Riffle, San Francisco; Hermann Weber, manager Petaluma Gas and Electric Company, Petaluma, Cal.: Fred A. Rasch, Portland Gas Company, Portland, Ore.; A. Ross, Independent Gas and Power Company, San Francisco; W. E. Osborn, manager Woodland Gas and Electric Company, Woodland, Cal.; W. G. Conlisk, secretary California Gas and Electric Corporation, San Francisco; J. E. Poingdestre, manager Grass Valley Division Nevada County Gas and Electric Company, Grass Valley, Cal.. The above members were present at the meeting. Those who were elected but were not present are: Henry L. Doherty, engineer Denver Gas and Electric Company, Denver, Col.; J. W. Morton, San Francisco; F. A. Leach, Jr., Oakland Gas, Light and Heat Company, Oakland, Cal.; John Klepper, superintendent Phœnix Gas Company, Phœnix, Ariz.; Thomas W. Brooks, San Francisco; R. M. Adams, Los Angeles Lighting Company; Los Angeles, Cal.; Roderick McKay, Los Angeles Lighting

Company, Los Angeles, Cal.; H. M. Corlette, Los Angeles Lighting Company, Los Angeles, Cal.; W. J. Dorr, Los Angeles Lighting Company, Los Angeles, Cal.

Mr. F. H. Eichbaum, one of the oldest members of the gas profession on this coast, who is about to retire from the gas business on account of his advanced years, was made an honorary member of the association. The Tuesday afternoon session was taken up by L. P. Lowe's paper on "Practical Protection of Metal Surfaces in Gas Plants" and John A. Britton's paper on "High Pressure Gas Distribution" and the resulting discussion thereon.

At 8 o'clock in the evening a popular lecture on "Liquid Air," accompanied by experiments, was delivered by Professor G. A. Bobrick, which was attended by many ladies of the families and friends of the members. At the conclusion of the lecture the entire audience repaired to a local hostelry where a light supper was enjoyed. Wednesday morning's session was taken up by Dr. C. T. Deane's paper, entitled "The Oil Industry of California From a Commercial Standpoint," and Franklin Riffles' paper on "Wrought Pipe."

At the afternoon session Professor Bobrick's paper on "Liquid Air—It's Application to the Gas Industry," D. Decker's contribution, "Our Customers and Their Complaints," and the reports of the Wrinkle and Experience department were read.

The following officers were elected to serve for the ensuing year: President, W. A. Aldrich, Spokane, Wash.; vice-president, L. P. Lowe, San Francisco, Cal.; secretary and treasurer, J. B. Grimwood, San Francisco, Cal. For directors to act with the above: John Martin, San Francisco, Cal.; H. C. Keyes, Sacramento, Cal.; C. H. Pennoyer, San Jose, Cal.; George S. Colquhon, Fresno, Cal.

A short topic was to have been presented by J. B. Grimwood on "Peak Loads in the Gas Business," but owing to the lack of time this paper had to be omitted, and the regular session of the Pacific Coast Gas Association was brought to a close at a few moments before 6 o'clock.

At 8 o'clock of the same evening fifty-four of the members sat down to the annual banquet, with J. A. Britton as toast master. The banquet proved a success in every respect, lasting until close to midnight.

Thursday morning the annual outing of the Associatian, consisting of a trolley ride to different points of interest was taken in special cars. Luncheon at the Cliff House, where the guests were entertained by the Hawaiian Glee Club, was one of the features of the day.

The social features of the Pacific Coast Gas Association convention formed one of its most important attractions. During the outing a large number of lady friends attended with the members, and responded with pretty and witty speeches at the different luncheons, which formed a cheery contrast to the dull routine of business.

That the Association is a necessity for the members and that it has become a permanent institution is shown by the increase in membership during the past few years and also by the money expended for the library during the same period. It is generally recognized that the Association has been of vast benefit to those engaged in the gas business, and the last convention was more of a success from a business and social standpoint than any of its predecessors.

ELECTRICITY VERSUS STEAM

Like most of our Eastern contemporaries, the Chicago *Tribune* seems to have its eyes glued to the territory east of the Mississippi River and ignores the vast development taking place in the empire west of the Sierras. Witness the following:

The proposed demonstration at Lansing, Mich., of a new system of electric railway construction is only one more of several denominations and tests which are slowly and apparently surely paving the way towards the future abandonment of steam as the motive power in land passenger transportation. It may be a long time yet before the steam locomotive gives way to the electric motor, but everything seems to indicate that the time is coming. If the experiments at Lansing prove successful they will show that a long step has been taken towards the substitution by reducing the cost of equipment at least one-third, doing away with substations, which would effect a large saving in labor, conserving the energy which is now dissipated in the stopping and starting of cars, and greatly increasing the speed. An experiment which promises so much will be watched with great interest.

Meanwhile, whether the experiment succeeds or not, it is evident from the way in which capitalists are planning to build electric lines over long distances that these lines are seriously cutting into the business and revenues of the steam roads. Already steam railroad companies in some parts of the country are buying up electric lines and using them as feeders for local territory they cannot reach, but more significant than this is the organization of companies to build long electric lines, like those proposed between Chicago and Detroit, Chicago and Indianapolis and the proposal to parallel the Boston and Albany road with a branch from Springfield to New York. The railroad men profess not to fear the competition, as it will be impossible to get electric cars through from Boston to Albany in anything like the time trains now make. This is not so certain, for already the maximum of 100 miles per hour has been made in Germany. What can be done in Germany can be done here. The obstacle now standing in the way is that such speed on an electric road would not be legal in Massachusetts or in New York. The most serious factor in the problem now is that it does not pay to use electricity on long distance trains, but if Mr. Arnold's experiment, or the experiments of others in the same direction prove successful, and electricity can be made cheaper than steam, then, as a matter of course, the roads will use it. It may be a long time before this is the case, but events seem to be shaping themselves to such a result.

Steadily and surely the electric roads in California are encroaching on the steam traffic with unequivocal success and the Western managers of steam railroads are fully alive to the situation, and are changing their power as fast as possible, especially for suburban travel, to electric equipment.

Long distance transmission was evolved in California, and its progressiveness will give to the world the solution of the many problems which the East is now slowly grappling for.

ALLIS-CHALMERS COMPANY.

THE report of the Allis-Chalmers Company covers the fiscal year ending April 30, 1903. The president's report shows that the profits for the year, after deducting all charges for depreciation, maintenance and repairs, amounted to $1,653,576. Dividends amounting to 7 per cent. were paid on the preferred stock, leaving a balance of $516,076 to be carried to the surplus funds. This, added to the surplus at the beginning of the year, leaves a total of $820,836 as the net surplus at the close of the year.

The company's cash account shows the amonnt in bank at $1,628,009; in addition to which there were current realizable assets of $6,243,333, making a tctal of $7,871,342. The orders unfinished and on hand at the close of the year amounted to $8,797,483, an increase of $640,448 over the end of the preceding year. The outlook for work is excellent, and the business offered is in excess of the present facilities, although the completion of the new works will enable the company to take all that is offered.

The controller's report shows that the net outlay for the new plants and extensions during the year amounted to $2,791,898. This includes only actual increase of plants, all expenditures for maintenance and renewals having been included in the current expenses. The capital stock of the company amounts to $36,250,000, of which $16,250,000 is preferred and $20,000,000 common stock.

President Charles Allis' report says: "The demand for the products of this company has continued through the past year largely in excess of the capacity of the works, although the output has been greatly increased. The operations of the various works have, as last year, been greatly hampered and restricted on account of the many changes made in specializing the work and incident to the completion of the West Allis plant, where the largest and heaviest engine work is now being manufactured.

"The new works at West Allis, near Milwaukee, Wis., are rapidly approaching completion, there now being employed at this plant nearly 1200 men, which force will be increased to about 2000 within the next few months. These works are acknowledged by experts to be as near perfect for economy and facilities of production as anything in the world, and when the present plans of the company are completed, there will be added from five to six million dollars annually to the volume of the business of the company.

"The management has continued its policy of bringing all its plants to the highest efficiency, and has introduced the system of electric motors for all machines, thereby enabling the company to manufacture its product at all its works at a greatly decreased cost. Contracts have been let for the installation of automatic sprinklers and the most improved fire equipment at respective plants, thus effecting a large saving in the cost of insurance and reducing the danger of interruption to their continuous operation."

The directors' report says: "Three of the great units of the West Allis works, as designed by Edwin Reynolds when chief engineer (now consulting engineer) of this company, are now practically completed. Extensions of all other plants have also been made or are in progress. These additions of real estate, buildings and machinery to the productive property of the company have absorbed $3,069,897 of the cash capital originally provided for these purposes. All the property of the company is owned in fee, is free from mortgage or other lien, and is covered by insurance. No mortgage can be placed upon the property without the assent of 75 per cent. of the amount of preferred stock outstanding.

"The reports of the president and comptroller show that the properties have been maintained, that liberal provisions have been made for depreciation, that quarterly dividends upon the preferred stock at the rate of 7 per cent. per annum have been earned and paid, and that $516,076 remain of the net surplus earnings from the operations of the company for the fiscal year ending April 30, 1903, equivalent to more then 2½ per cent. for that period upon the common stock. During the past year, as well as the previous year, the charges to capital have comprised only such expenditures as created additions to the plants for increased output, while, during the same two years, all the costs of repairs, renewals and replacements, for the maintenance and increase of efficiency and economic operation, for the better protection of the property and business from the risks of fire (as prescribed by the most exacting of the mutual fire associations), and the expenses of rearranging tools and equipment, have all been charged against the current revenues of the company.

"The development of the business of the company during the past year has been most satisfactory, particularly in various lines not hitherto given special attention, thus giving the company in the diversity of its products broader fields for its manufactures and greater stability for its industries. Its principal departments are now classified and its works specialized for the manufacture of steam, gas, blowing, pumping and hoisting engines, compressors and complete installations of electrical power stations, mining, metal reducing, sawmill, flour-mill, crushing, cement, water works and sugar machinery. The amount of unfilled orders on hand May 1st last was sufficient to keep all the present works in operation during the current year without considering the increased facilities that are in process of early completion. The increased volume of work on hand, the extent and variety of that offered, and the enlarged facilities for its production, constitute assurances of business that justify the stockholders, as well as the management, in expecting satisfactory results for the current year."

OBITUARY.

Thomas Chalmers, father of W. J. Chalmers, Chairman of the Executive Committee of Allis-Chalmers Company, died July 13th and was buried Thursday July 16th. Thomas Chalmers was the founder of the firm of Fraser & Chalmers, which firm was recognized as the world's largest producers of mining machinery.

A sketch of Mr. Chalmers' life in Chicago would be almost a history of the city's industrial growth. He built Chicago's first waterworks, a single-pump at the foot of the river, and during his early career as a machinery manufacturer he was the largest builder of sawmill machinery in the United States.

In 1855, with P. W. Gates, E. S. Warner, A. G. Warner and David R. Fraser, Mr. Chalmers formed the firm of Gates, Warner, Chalmers & Fraser which was succeeded in 1857 by the Eagle Works Manufacturing Company. In the winter of 1871-72 this corporation was dissolved, and with Mr. Fraser, Robert Anthony and David Marchant Mr. Chalmers formed the firm of Fraser & Chalmers. Two years ago, this company with three others, was merged into the Allis-Chalmers Company.

SOME RECENT ALUMINUM ORDERS.

THAT the prejudice against aluminum wire is rapidly disappearing is well illustrated by the number of important orders for this metal which have recently been secured from Pacific Coast concerns.

The Snoqualmie Falls Power Company have ordered sufficient bare main-line wire for all of their new extensions, as well as heavy weather-proof wire for local distribution in the City of Seattle. This wire is now being delivered.

Probably the most important Pacific Coast order for aluminum wire received since the Standard Electric Company of California and the Bay Counties Power Company systems began operations, is that of the American River Electric Company for their plant above Placerville, with lines extending into Stockton and the Mother Lode district. It is the intention of this company to run two independent pole lines each carrying three No. 1 B and S. G. seven-strand bare aluminum wires. The length of each pole line will be approximately ninety miles, not counting the various branches. A marked departure from former methods of construction in these lines will be the spacing of the poles which will be approximately 180 feet apart. Locke 329, fourteen-inch, 60,000 volt insulators will be used. By the wide spacing of poles permitted by the use of aluminum wire, a very considerable saving will be made in the cost of these lines.

INDUSTRIAL

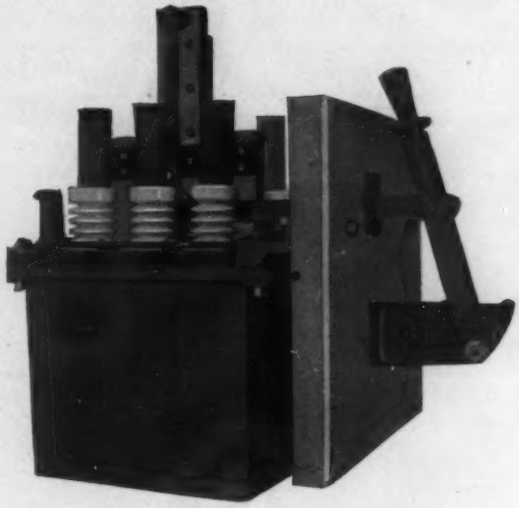
"G. I." HIGH TENSION SWITCHES.

FOR the past three years The General Incandescent Arc Light Company has been furnishing a complete line of high tension switching and controlling apparatus in which are eight distinct types of oil switches, which vary from 2500 volts to 25,000 volts, and range in ampere capacity to any desired amount. They are designed to meet a great variety of requirements incident to equipping modern central stations of the largest size. This company has equipped the entire high tension electrical controlling apparatus of such plants as the St. Paul Gas Light Company, the Brooklyn Edison Company, the Chicago Edison Company and large part of the equipments of the New York Edison Company, besides many other important large plants throughout the country.

The "G. I." Company has made a specialty of automatically controlled oil switches. For example, any of the eight types of oil switches can be supplied with an overload device which will cause the oil switch to immediately open in case of an overload or short circuit, or by the interpellation of a "G. I." time limit relay the opening of the switch can be delayed any desired amount up to five seconds. These switches can always be supplied with reverse current relays, the function of which is to cause the switch to open the circuit upon the reversal of the direction of the transmission of power. This is a very important feature, and one that is thoroughly taken care of by the "G. I." apparatus.

A distinct feature of the oil switch overload attachment lies in the fact that the mechanism by which the switch is manually closed is so designed that if it is closed upon an overload condition, such that an excessive amount of current would flow when closing the switch, the latter immediately flies open through the instrumentality of the overload relays and device opening the switch, irrespective of the fact that the operator may still have his hand upon the closing mechanism at the time. In other words, it is impossible to hold the oil switch closed against a short circuit or overload condition.

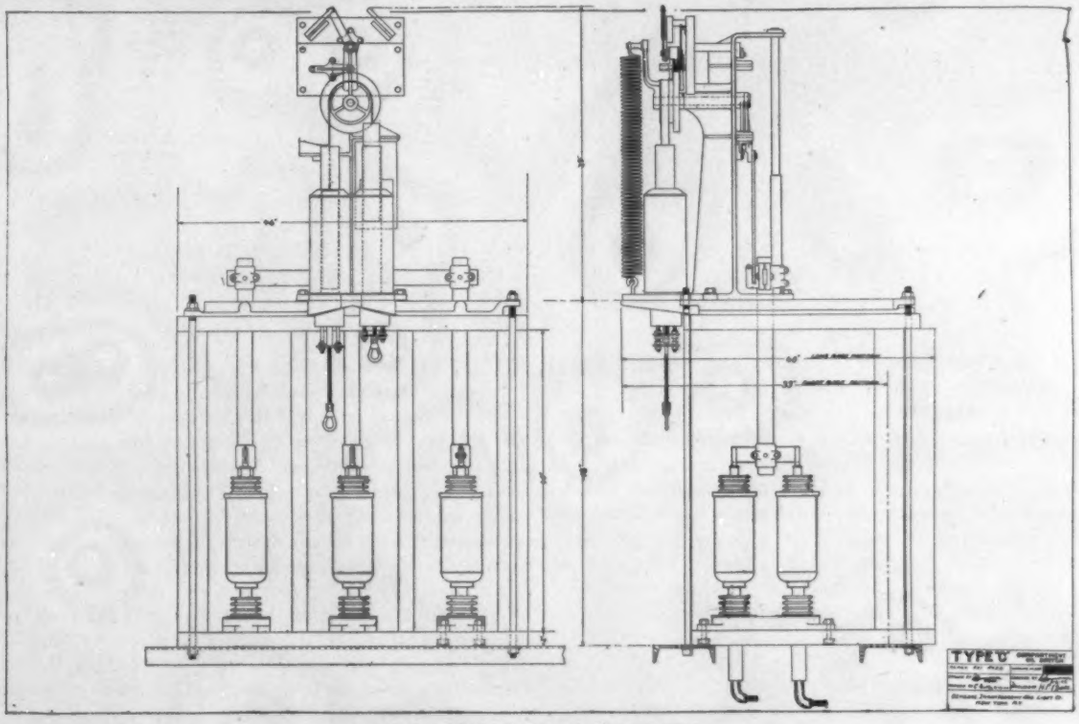
The universal tendency to design all central station apparatus so that it can be controlled from a switch-controlling board, has led the "G. I." Company to provide the oil switches with solenoid control, so that they can be installed at the most convenient places in the station, no matter how remote from the controlling switchboard. Heretofore this feature, when used, has been confined to the main switches of the station, but it has been found, however, that great saving in the cost of installation, as well as greater facility of operation, is attained by making the smaller apparatus



"G. I." TYPE "B" OIL SWITCH

for remote control. This has been accomplished by the solenoid-operating mechanism provided for this purpose, which operates in a similar manner to solenoid control of the larger switches, but only of a smaller design.

Another distinct feature of the "G. I." oil switches lies in the fact that certain types are designed as double-throw switches in one and the same switch. It has been customary, before the "G. I." Company designed these double-throw switches, to use



DETAIL OF "G. I." TYPE "C" OIL SWITCH

two single-throw switches, arranged with an interlocking device, more or less crude, to prevent them from both being thrown in at the same time. The use of a double-throw switch is, of course, ideal in this respect, and the "G. I." Company's Type G switch is designed to operate up to 15,000 volts, with capacities up to 300 amperes in the double-throw design.

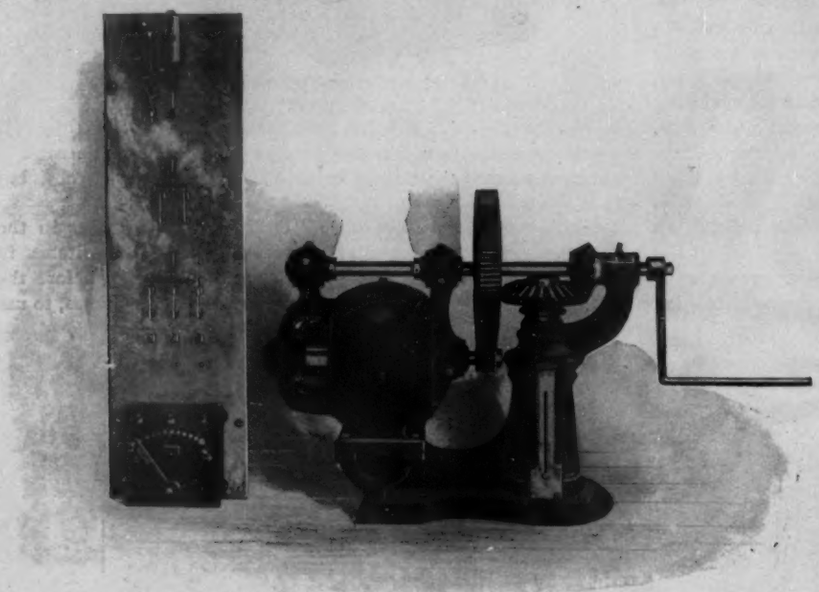
The above is simply an abstract of that which the "G. I." Company has been doing in this respect, as it is impossible in a short statement to mention the greater part of apparatus of this kind which is more or less of a special nature, but which oftentimes is found to be almost indispensable in the satisfactory equipment of a central station.

The illustrations herewith show the Type C switch, which is designed to meet the most severe duty that could be placed upon the switch in a large central station, where enormous generators are used, and where the largest factor of safety is necessary. The other illustrations show the Type B switch, which has been designed more especially for disconnecting busbar connections, or where smaller amounts of power are to be interrupted in small central stations or in substations.

Bulletins and descriptive matter will be gladly furnished from the Pacific Coast office, 629 Mission Street, San Francisco.

MOTOR OPERATED VALVE STANDARDS.

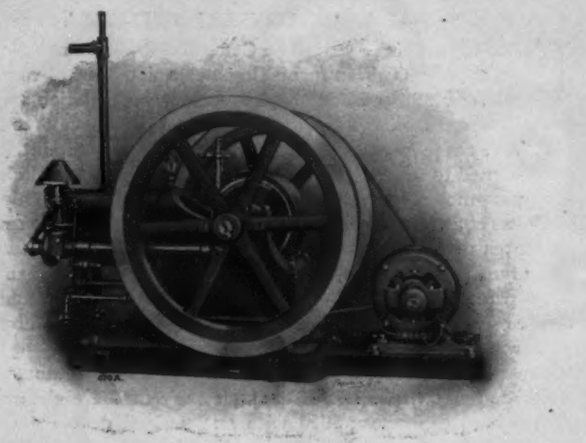
IN the last few years important progress has been made in the operation of sluice valves. The attention of manufacturers of such valves has been directed to their operation by electric motors, making it possible to operate the valve at considerable distance from the generating station.



NORTHERN BACK GEARED MOTOR DIRECT CONNECTED TO 48-INCH COFFIN SLUICE VALVE

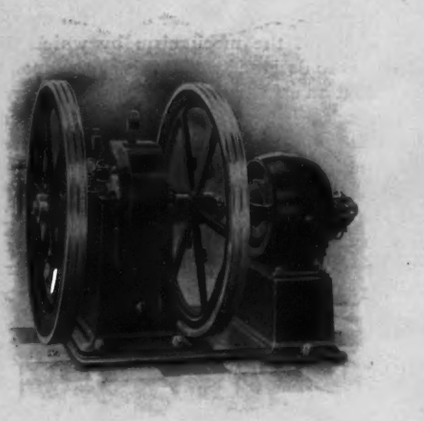
Besides reducing the amount of labor required to man a hydraulic installation the motor operated valve is rapid in operation. A forty-eight inch sluice valve geared four to one can be operated by manual labor in from twenty to thirty minutes. A similar valve equipped with an electric motor accomplishes the same task under like conditions in from three to five minutes. Suitable controlling apparatus makes it possible to eliminate all danger in the operation of the valve.

The joint pioneers in the work of evolving motor operated sluice valves are the Northern Electrical Manufacturing Company, Madison, Wis., and the Coffin Valve Company of Neponset, Mass. Efforts of the engineers of these two companies have produced a novel, speedy, efficient motor operated valve standard such as is illustrated herewith. The engraving also shows the controlling mechanism supplied where it is desired to disconnect the current to the motor when the valve is operating or closing. The crank which appears in the engraving is supplied for use where it is desirable to begin the operations of opening and closing the valve by hand.



NORTHERN GENERATOR BELT DRIVEN FROM LEWIS GAS ENGINE

The Northern Electrical Manufacturing Company of Madison, Wis., has in preparation a bulletin illustrating fully the electrically operated valve standard. Engineers interested in the subject are invited to send in requests, which will be filled on the completion of the bulletin.



NORTHERN GENERATOR DIRECT CONNECTED TO LEWIS GAS ENGINE

Bulletins will be furnished on application to the main offices of the company, Madison, Wisconsin or from any of the Pacific Coast offices of Jno. Martin & Co. agents.

THE NORTON COMPANY'S EQUIPMENT.

THE Norton Coal Company, of Norton, Virginia, are expanding their plant and adding coke ovens, for which extension they have recently purchased from the Westinghouse Electric and Manufacturing Company two additional generators with their equipment, etc. This company already have in use two 100-kilowatt, belted, 250-volt, Westinghouse generators, together with two Baldwin-Westinghouse mining locomotives, switchboard and other auxiliary apparatus, making a complete electrical installation for mine haulage purposes.

The Duke of Marlborough, following the example of other progressive members of the British aristocracy, has ordered two electric elevators with push-button control from the Otis Elevator Company. These are to be installed in his city home, Blandford House, Curzon Street, London.